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U. S. DEPARTMENT OF AGRICULTURE.
OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 148.
A. C. TRUE, Director.

REPORT

ON

IRRIGATION INVESTIGATIONS IN HUMID SECTIONS OF THE UNITED STATES IN 1903.

UNDER THE DIRECTION OF
ELWOOD MEAD,
Chief of Irrigation Investigations.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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[Continued on third page of cover.]

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LETTER OF SUBMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., June 8, 1904.

Sir: I have the honor to submit herewith a report on investigations and experiments in irrigation in different parts of the humid region of the United States carried on by this Office in 1903. The report deals almost exclusively with the irrigation of market-garden crops. Most of these grow rapidly and have but a short season, and a few days of dry weather seriously check their growth. There are few seasons when such dry periods do not occur, and irrigation as an insurance against them has proved very profitable. In some sections this is becoming so well known that many inquiries are received as to equipment and methods of irrigating. The report of Professor Voorhees describes a number of plants now in use, and will be useful in answering such inquiries.

In sections farther west there is doubt as to the value of irrigation and some prejudice against it, and the experiments at Columbia, Mo., reported by Professor Waters, have been made for the purpose of testing the value of irrigation in that section. As may be seen from the report, irrigation has generally proved profitable.

The report of Professor Crane on the artesian basin of South Dakota shows that there have been large preparations for irrigation, but that the use of too much water has swamped the land and has in this way created a prejudice against irrigation in general and especially against the use of artesian water. However, irrigation is still practiced by market gardeners with good results, and experience has shown that there is no danger in the proper use of the artesian water. It is the use of too much water, rather than the quality of the water, which has done the damage.

The great success of irrigation of market gardens and the increased demands for agricultural products are leading to the adoption of irrigation for field crops in the humid sections of our country. In this the farmers of America are repeating the experience of farmers of Europe, who have found that there are few sections where irrigation will not pay simply as an insurance against drought. The irrigated portions of France, Switzerland, and Italy have a greater rainfall than the Mississippi Valley. The average rainfall for eighty years of the largest irrigated district in Europe is 40 inches, and is better distributed than the rainfall of Ohio, Illinois, or Iowa.

There is every reason to believe that as population increases and land becomes more valuable the zone in which irrigation can be profitably employed will be extended in this country as it has been in Europe. With higher-priced crops and more intensive cultivation irrigation will inevitably take its place as an important agency in the agriculture and horticulture of the eastern half of the United States.

Respectfully submitted.

ELWOOD MEAD,
Chief of Irrigation Investigations.

A. C. TRUE, *Director.*

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REPORT ON IRRIGATION INVESTIGATIONS IN HUMID SECTIONS OF THE UNITED STATES IN 1903.

IRRIGATION IN MARKET-GARDEN DISTRICTS IN THE VICINITY OF EASTERN CITIES.

By Edward B. Voorhees,
Director of the New Jersey Agricultural Experiment Stations.

During the summer of 1903 market gardens in the vicinities of New York and Boston were visited for the purpose of ascertaining the approximate cost of irrigation for such gardens and the profits due to the use of water. It was not the intention to gather statistics showing the extent of irrigation, but rather to secure the facts relating to typical systems. There are many other plants besides those described, but they are not peculiar in any particular, and their descriptions would not add to the value of this report.

TYPICAL IRRIGATION SYSTEMS.

W. F. TABER & SON, POUGHKEEPSIE, N. Y.

This plant has been in successful operation for several years and is used chiefly for the irrigation of berries, the area ranging from 4 to 6 acres. Mr. Taber is enthusiastic over the advantages of irrigation. It guarantees, first, a perfect stand and rapid growth of newly set plants; second, the highest quality of product; and third, maximum crops.

The equipment consists of a 14-horsepower gasoline engine, located near a small lake which provides for any possible demands for water even in the driest times; 1,000 feet of 2½-inch iron pipe, which is laid to the nearest point of the area to be irrigated; and 100 feet of 2-inch duck hose, which is attached to the main pipe. Mr. Taber uses the sprinkling method of irrigation almost exclusively. For this he uses a fire nozzle which is 18 inches long with a ¾-inch opening and 1-inch reduction. He has also perfected a form of flat nozzle to be attached to the fire nozzle without reduction, which enables him to obtain a fine spray. This gives a spray 4 inches wide. A ¼-inch opening is found to be most practicable with his water pressure and will send a spray 40 feet. He is particularly pleased with his form of irrigation, as it resembles in its effect a steady rain. Owing to the dry weather and high temperature during the season of 1903 his raspberries colored and hardened but did not sweeten. By the application of 10,000 gallons of water per acre, in a fine shower directly upon the fruit, the berries were put in first-class condition, well ripened and plumped out, and were ready for picking the next day. Following this spraying 25,000 gallons per acre was applied between the rows, these being the only applications needed during the dry season. He also irrigates immediately after applying chemical fertilizers rich in nitrogen, as it removes the danger of any injury to plants and also dissolves and distributes the plant food. In 1902 plant setting was successfully completed only because it was possible to previously irrigate.

PHILIP BACH, FLUSHING, LONG ISLAND.

Mr. Bach has 30 acres, all under irrigation and growing various kinds of garden truck, as lettuce, onions, beets, cauliflower, and celery. His plant, which he has used for seven years, includes a 5-horsepower engine and pump and a 10,000-gallon tank, which is set 25 feet above the surface of the ground. The water is carried from the tank by underground pipes. From hydrants placed at various intervals the water is discharged into a 2-inch gas pipe 50 or 60 feet long with six or seven 1-inch upright branches from 4 feet to 8 feet in height. To each upright is attached a "water witch," which throws a spray as heavy as a hard shower about 8 feet on each side. He has no method of measuring his water, but uses it whenever he judges it necessary and allows the witches to run one hour in one place. The pipe is then removed to the next area. It can be handled by three men, one taking each end of the pipe and the other the middle. The entire cost of his plant is estimated at $2,000. He estimates that the irrigation of his crops has been worth at least $5,000 to him this year, though the value naturally varies with the season.

FRED SCHUMACHER, FLUSHING, LONG ISLAND.

Mr. Schumacher irrigates from 15 to 18 acres, planted to onions, lettuce, celery, and carrots, and occasionally an additional area of cauliflower. He is satisfied that it would be profitable for cabbage, potatoes, and corn also. His equipment consists of a 2 to 3 horsepower engine and a 10,000-gallon tank. The water is obtained from a spring and pumped to the tank about 75 feet above the spring. He has also put in a windmill, which raises enough water in moderately dry weather. The water is carried from the tank in 2-inch galvanized iron pipes 100 to 200 feet apart, which are tapped every 200 feet. At these points 1-inch garden hose 20 to 100 feet long is attached and connected with a gas pipe 45 feet long fitted with "water witches"

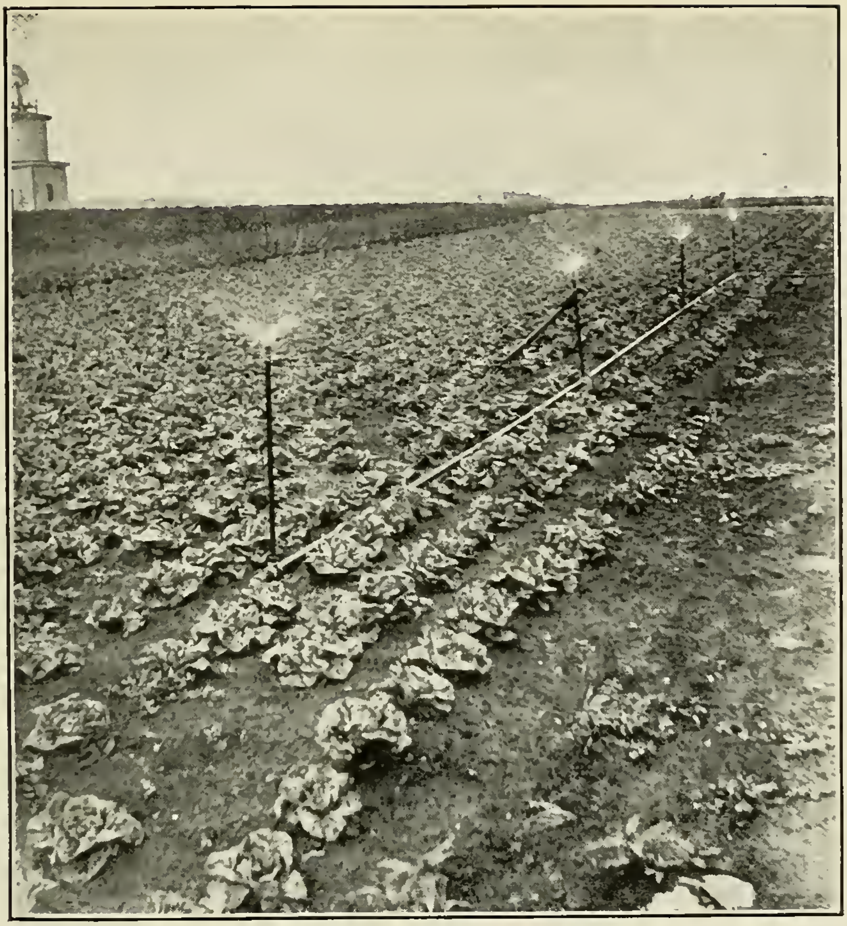

FIG. 1.—GAS PIPE AND SPRINKLERS USED BY FRED SCHUMACHER, FLUSHING, LONG ISLAND.

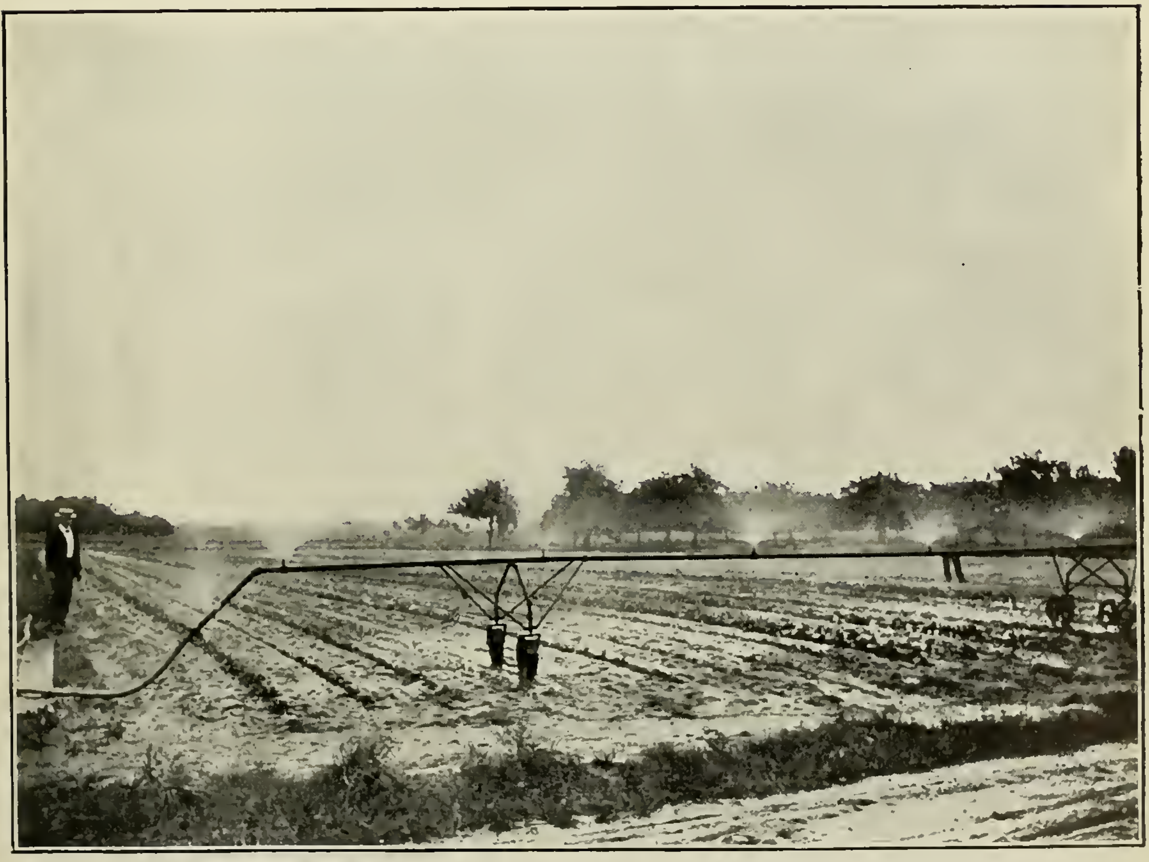

FIG. 2.—MOVABLE SPRINKLER USED BY DAVID ASTLE, VINELAND, N. J.

similar to those described above. (Pl. I, fig. 1.) It requires two men to tend the witches and one man to run the engine. He has no method of measuring the water and does not know how much he uses, but he adds water until he thinks the plants are sufficiently supplied. His plant cost about $1,500 and has been in use four or five years. He estimates his net profit from irrigation to be $500 a year.

JOHN SCHUMACHER, ELMHURST, LONG ISLAND.

Mr. Schumacher irrigates 6 to 8 acres of onions, lettuce, celery, radishes, and carrots regularly, and cauliflower and cabbage when the weather is dry. He obtains his water from the city reservoir and pays $3 per thousand cubic feet for the first thousand, $2 for the second, and $1 per thousand thereafter, and finds it is cheaper for him to purchase from the city than to provide his own pumping plant, which he formerly had, as the total cost of water used annually is only about $200. The water is carried in pipes and applied by the same method as that used by Fred Schumacher. He has irrigated for about ten years, and while he has no definite data as to the profits, he feels certain it pays, and says he would not attempt to grow market-garden crops without a guaranty of an abundance of water when needed. His experience teaches that it is necessary to water thoroughly, and he therefore soaks his soil at each application. Such plants as lettuce and celery he waters daily.

H. SCHUMACHER, JERSEY CITY, N. J.

Mr. Schumacher also uses city water, for which he pays at the rate of $1.50 per thousand cubic feet. He applies the water by means of a single "water witch" at the end of hose of varying lengths. He irrigates chiefly celery, beets, and lettuce, and applies water to about seven to eight acres. The cost of water ranges from $100 to $150 per year. He has kept no record of the cost of its application other than the cost of water. His estimate of the net profits from irrigation is from $500 to $1,000 annually from the area mentioned.

W. W. RAWSON, ARLINGTON, MASS.

Mr. Rawson has irrigated market-garden crops for twenty-five years. His plant consists of pumps and piping. His pumps have a capacity of 2,000 gallons per minute, and when they are working to their full capacity it requires four men to handle them and apply the water when irrigating in furrows. When irrigating small garden truck it requires three or four times as many men, although usually some are using one method and some another. The water is drawn from a river and is usually pumped directly into the pipes, as he has only a small tank for storage for use in sprinkling and watering plants. Such crops as cabbage and squash are irrigated in furrows; whereas cauliflower, beets, onions, lettuce, celery, etc., are irrigated by means of an ordinary nozzle, a man holding his finger over the opening to form a spray. He has no definite figures as to the cost of his plant, since it is virtually a development from a small beginning twenty-five years ago, improvements being made from time to time as his business increases. He does not keep an exact record of the profits derived from the irrigation, but he states that crops are often increased 50 per cent, and nearly always as much as 25 per cent. He aims to apply an inch or two of water every two or three days on large crops where furrows can be used, but on small crops not so much is used at a time, but it is applied oftener.

W. H. ALLEN, ARLINGTON, MASS.

Mr. Allen uses a pumping plant which is not in first-class condition, as it has been used so long that the pipes are rusted and the pump is in poor condition. He therefore supplements his supply from the city mains. He uses the furrow method for cabbages, cauliflower, squash, etc., and sprays small plants with an ordinary nozzle. He has no definite idea of the cost of irrigation, as in addition to using water for irrigation he uses it for greenhouse work and for washing. He runs water on the land until it is thoroughly saturated. His records do not show the financial advantages of irrigation, though he knows that it pays well, and would not attempt to grow crops, in the dry season particularly, without irrigation.

HITTINGER BROTHERS, BELMONT, MASS.

This firm obtains its water from a brook and springs on the hillside above its land and the cost of irrigation is limited to the expense of piping and storage. The storage tank holds 50,000 gallons. Irrigation is confined entirely to strawberries. Watering is begun when the strawberries are small, using a 1-inch hose with an ordinary open nozzle, but when the berries are ripening the land is flooded. At each wetting about 10,000 gallons is used on 4.5 acres, or about 2½ inches in depth. This is put on about once a week. One man can irrigate three or four acres in five or six days, and the cost is limited to the labor of the man. This year (1903) strawberries were irrigated four times before the drought ended, and would not have produced any fruit if irrigation had not been practiced. With irrigation 2,629 quarts were picked from 1 acre, and the berries sold at prices averaging a little more than 23 cents per quart, giving a gross return of more than $600 per acre. The firm has no definite idea of the cost of its cistern and piping and could not estimate the total cost of watering the berries, as the plant serves also to supply water to their greenhouses and washing tanks.

WYMAN BROTHERS, ARLINGTON, MASS.

This plant has been in operation for twelve to fifteen years. The original cost was about $5,000, but $2,000 has been spent on it since. The water is pumped from wells by the side of a lake and stored in a cistern with a capacity of 100,000 gallons. The cistern is used only when little water is needed for the greenhouses and ordinary washing. In irrigation proper the pumps are connected directly with the distribution pipes. One 4-inch main carries the water over the farm, and to this are attached 3-inch laterals. This system is arranged to cover 50 acres, only parts of which are irrigated each year, according to the crops. From the hydrants on the 3-inch laterals 2-inch pipes are laid on the surface, so that with 100 feet of hose, usually 1 inch, every part of the land may be reached. Cabbage, cucumbers, squash, and celery are irrigated by the furrow method, using hoe cultivation, but the lettuce, beets, onions, etc., are sprinkled. The plant is being run to its full capacity. There is one man at the engine, two or three men carrying pipes, and six or seven men using the hose, depending on the method used and the crop, or a total of from nine to twelve men. These irrigate, on the average, from 5 to 6 acres per day, putting on an inch of water, as nearly as can be estimated from the capacity of the pumps, which exceeds 10,000 gallons per hour. In dry weather the crops are irrigated every two or three days, or are given 2 or 3 inches per week, according to the crop. It is claimed by this firm that irrigation makes the difference between profit and loss on the market-garden crops that are grown, but there was no definite statement made as to the profits of the business.

F. H. COOLEDGE, WATERTOWN, MASS.

This is one of the largest of the plants described. It is possible to irrigate 100 acres, if necessary. While a number of small storage tanks of perhaps 11,000 gallons capacity are provided, these are not depended on. The pumps, with a capacity of 4,000 to 6,000 gallons per hour, are placed in driven wells and are connected directly with the distribution pipes, and connection with the cisterns is shut off. Mr. Cooledge aims to have 100 pounds of pressure, as part of his land is hillside. The sprinkling method of irrigation is used exclusively, a perforated nozzle being attached to a 1¼-inch hose. The crops irrigated include cabbage, lettuce, squash, radishes, beets, celery, carrots, peas, etc. When irrigating it requires one man at the pump and from eight to ten men at the hose. The water main to carry the water from the pump is 4 inches in diameter and is buried, but on the fields 3-inch pipes are laid on the surface of the ground, and are taken up in the fall and put down in the spring. The pipes are laid so that with 100 feet of hose every part of the farm can be reached. He estimates that from eight to twelve men will water eight to ten acres daily, depending on the crop and the method. In the fall he waters celery, even though he has showers every other day. He has no data concerning the cost of plant or of the labor involved. The expense, other than labor, when the plant is in full operation is equivalent to 1 ton of coal per day. He believes thoroughly in the advantages of irrigation and knows that it pays.

DAVID ASTLE, VINELAND, N. J.

The plant of Mr. Astle is located on the sandy soils of Vineland, N. J., and illustrates nicely the advantages of irrigation for such soils and for general market crops, including potatoes, beets, onions, tomatoes, celery, Lima beans, cabbage, etc. His supply of water is drawn from driven wells and is pumped into a tank and from thence distributed and applied by means of pipes and movable sprinklers. A form of sprinkler has been devised by Mr. Astle which is well adapted for use on level ground. The supply pipes run along one side of the field to be irrigated, and lateral pipes are attached at different points. A long pipe, supplied at intervals with spraying nozzles and extending across the field, is supported at a distance of about 6 feet from the ground by means of a framework and wheels. (Pl. I, fig. 2.) This is connected with the lateral pipe by means of a rubber hose, so that it can be pushed across the field. The ground is watered to the limit of the hose, when it is uncoupled and attached to the next tap on the lateral pipe, and so on. Mr. Astle began irrigating in 1899, trying it on an acre of cabbage. This was so successful that in 1900 he watered cabbage, potatoes, beets, onions, and other crops, with good results. A hayfield alongside of the irrigated plats received some of the water from these plats, and the crop was fully twice as heavy as that on the rest of the field. Irrigation has been continued with great success every year since. In 1903, on one plat of 1⅞ acres, Irish potatoes were grown first, followed by early celery. The total value of the two crops is estimated to have been about $800. This, of course, was not accomplished without heavy manuring, although it shows the possibilities of this light land when abundantly supplied with water.

F. W. KILBOURNE, NEW BRUNSWICK, N. J.

This plant is located within the limits of the city of New Brunswick. The supply pipe from the pumping station to the city reservoir runs through the farm. This pipe is tapped and water obtained direct from the reservoir at a cost of $1 per thousand feet. The area under irrigation is from 2 to 3 acres and is under intensive cultivation. Early cabbage, cauliflower, beets, onions, celery, spinach, and lettuce are chiefly grown. The land is always thoroughly saturated previous to setting plants, and irrigated afterwards as needed. The furrow system is used except for lettuce, which is sprinkled. The land has a slight fall, sufficient to carry the water slowly, and whenever irrigation of crops is practiced about 2 inches are applied and the land is immediately cultivated to retain the water. The cost of the water does not exceed an average of $25 per year, and when three crops are grown the average gross value is $1,500 per acre.

GEORGE A. MITCHELL, VINELAND, N. J.

The chief object of the year's work has been to perfect a low-priced pumping irrigation plant, in which the water is distributed mainly by gravity, but on occasion by sprinkling. The experience of the past six years shows that for gravity distribution the most important requisites are a large volume of water and the appliances necessary to deliver it at just the right time. These requisites have been secured in the past by pumping directly to the field with a 2½-horse-power gasoline engine and centrifugal pump, by which 100 to 125 gallons per minute can be delivered at the highest point of land on the farm.

In previous years the main pipe has been a homemade, tarred-cloth hose supported on poles. The poles began to weaken in 1902, so they were taken down and some 4-inch cast-iron pipe, taken from a greenhouse, was laid for a main. Near the top of the hill, where there was very little pressure, terra-cotta sewer pipe was used; some of this pipe was put together with Portland cement, some with oakum and red lead. The water is pumped with the same engine and pump formerly used, a little over 100 gallons per minute being delivered at the top of the hill. This pipe is just enough below the surface of the ground to allow plowing over it.

To secure the two conditions mentioned, a pond holding 50,000 gallons has been excavated at the highest point and the water empties into this through the iron pipe. There are three outlets of 2-inch pipe for letting out water when only a small volume is needed, and one outlet of 8-inch pipe which supplies the larger portion of the land to be irrigated.

Having secured a satisfactory water supply for irrigation, the next problem is the distribution of the water. The 10 acres which it is desired to irrigate slope in two general directions. On the main slope, however, there are two knolls, one of which has always interfered with irrigation in two ways. The water must be taken to the top through a long line of hose, and then if enough water is used to wet the top of the knoll the low ground will be too wet. By moving about 100 cubic yards of earth from the hill into the hollow both difficulties will be done away with and water will flow 750 feet, rendering 4 acres subject to easy irrigation by gravity. This work is partly done.

The other knoll mentioned is 2 feet higher, and there are fruit trees growing on it. Although the same difficulties exist there that have been mentioned concerning the other, the slopes are longer, and consequently the difficulties are not so great.

The objection is often heard that gravity irrigation will do in a few places, but that most farms in South Jersey are too flat. To test this, 1 square mile of the surrounding country was examined as to slope of land, and it was found that three-fourths of it has sufficient slope to render irrigation by gravity easy, while nearly all could be successfully irrigated by gravity if some leveling were done.

It is sometimes desirable to sow clover seed at a certain time; for instance, crimson clover needs to be sowed among squash or cantaloupe vines just as the runners start. Often the ground can be thoroughly wet by gravity irrigation, but sometimes it would be a great advantage to sprinkle. In view of this fact a low-wheeled wagon was purchased, to be used as a lumber wagon and, when occasion required, for mounting the engine and pump and hauling them into the field to be irrigated. The water can be brought to the pump in a ditch and carried to the sprinklers through several lines of hose. Since a centrifugal pump is used, it does no harm if the water is a little sandy.

The arrangements for the irrigation of the 10-acre farm are now such as the experience of six years would indicate as best for a low-priced irrigation plant. This plant could be duplicated for $325 if second-hand pipe could be secured as cheaply as was that now used. This estimate includes labor.

C. BECKER, VINELAND, N. J.

Mr. C. Becker has irrigated small plats of land for several years. After trying many methods of distributing water he decided to try sprinkling, as requiring the least labor. One-seventh acre was fitted with parallel 2-inch pipes laid 11 feet apart, and "water-witch" sprinklers were attached at distances of 20 feet. (Pl. II, fig. 1.) The cost of 4,000 feet of 2-inch pipe, at 12 cents per foot, and 200 sprinklers, at 50 cents each, would be $580 per acre. Reckoning interest plus the depreciation of the plant at 10 per cent of the cost, the annual cost of irrigation would be $58 per acre, not counting original cost of pumping plant, which is used for other purposes as well as irrigation, nor cost of attendance while irrigating, nor cost of pumping. The entire device is arranged to sprinkle without heavy expense of attendance. If greater pressure were used, the cost for pipe and sprinklers could be reduced about one-half, as shown in the description of Mr. Astle's plant (p. 14).

The water is supplied from a tank 10 feet deep placed 15 feet above the ground. The water is pumped into this tank from a well by a windmill when there is wind or by a gasoline engine when the wind fails.

In 1903 the original plan of growing three crops on this ground was not carried out on account of pressure of other work. Strawberries,

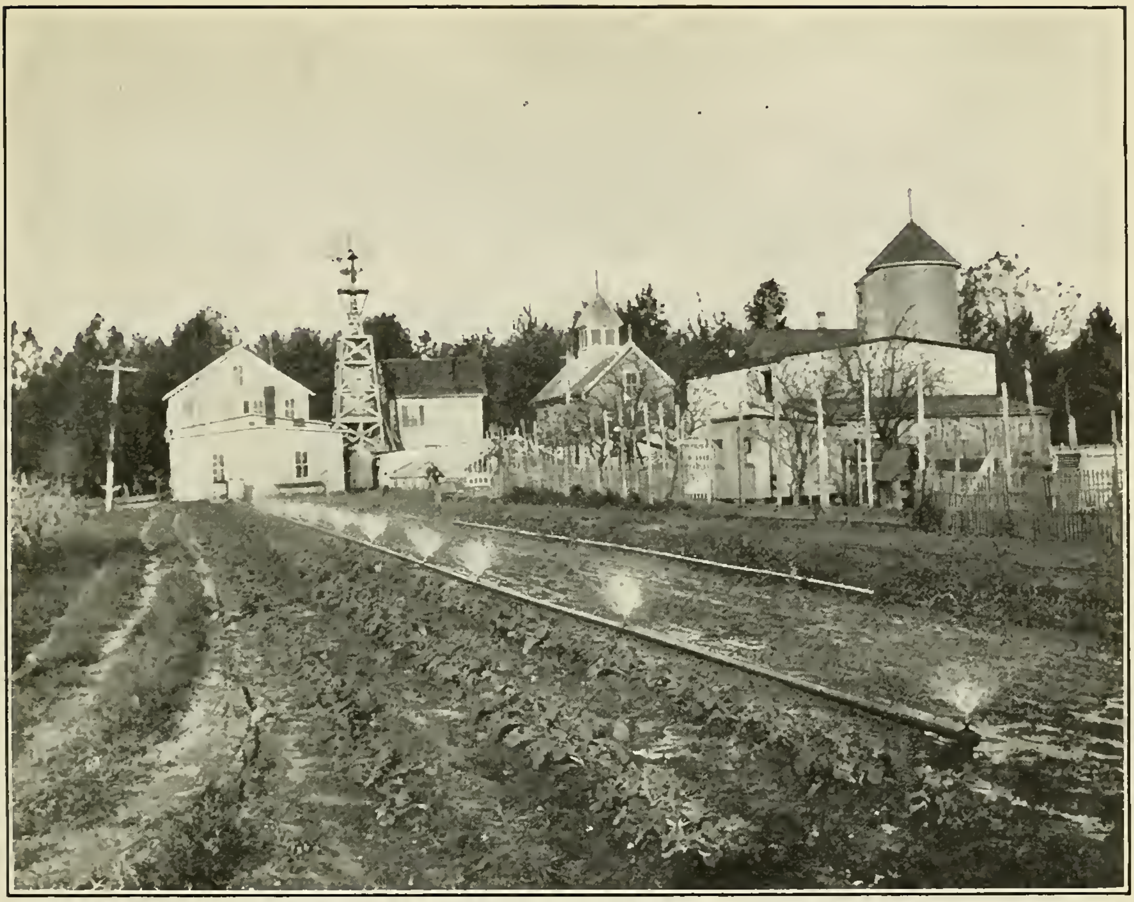

FIG. 1.—METHOD OF DISTRIBUTING WATER USED BY C. BECKER, VINELAND, N. J.

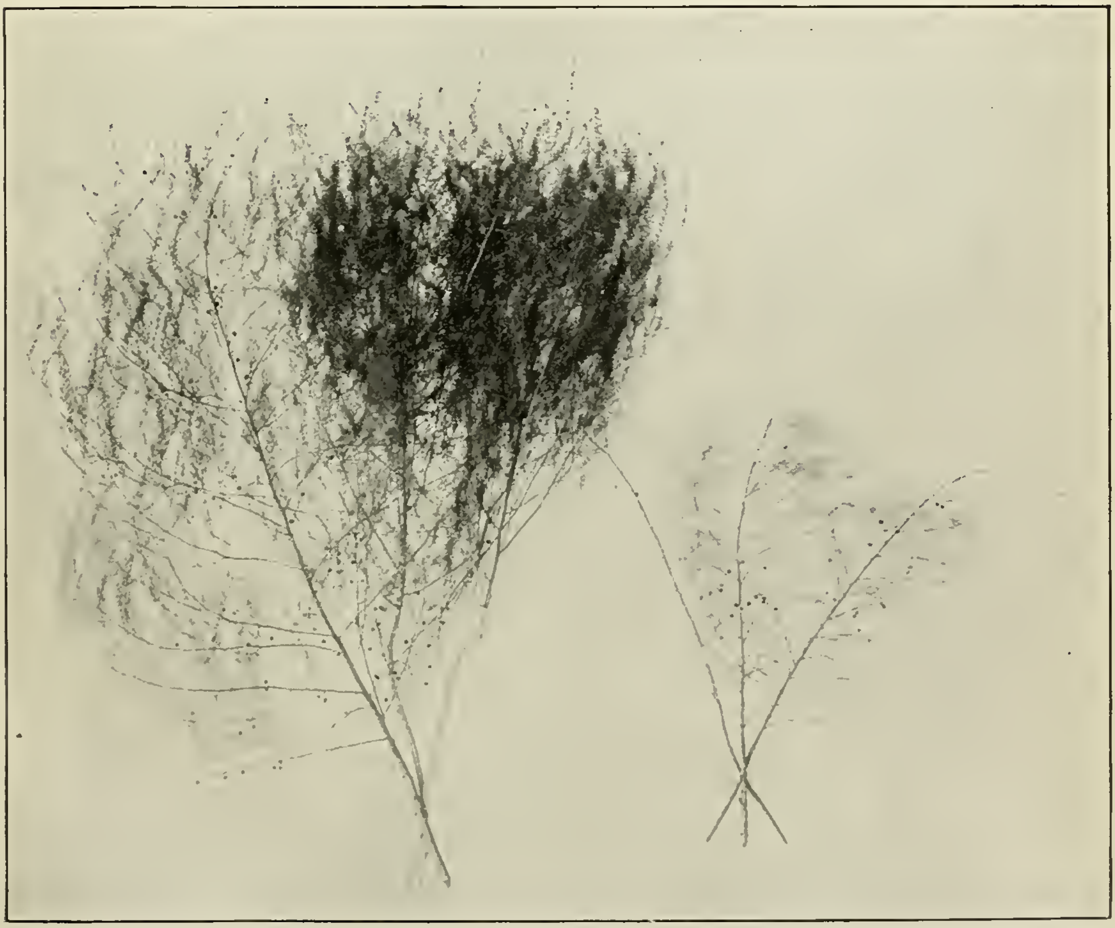

FIG. 2.—ASPARAGUS PLANTS FROM IRRIGATED ROW ON THE LEFT, FROM UNIRRIGATED ROW ON THE RIGHT.

beets, and onions were grown. Strawberries set out the last of September, 1902, grew so well under irrigation during the drought in the spring of 1903 that hundreds of plants yielded one quart each, the growth in many cases being so rank that some large berries ripened under the foliage while still having the green color.

Mr. Becker thinks he irrigated too frequently and by doing so caused too rank a growth. Every berry that set was ripened, there being no dried-up and spoiled fruit, as is common in this section. In the case of onions and beets the value of irrigation was shown by the fact that every plant produced a salable article. There is hardly a year when it is not too dry for onions and beets for at least a short time during the latter part of their growth.

Onions and spinach have been planted this fall (1903) preparatory to growing three crops next year and testing the full capacity of this method of gardening with the help of irrigation.

IRRIGATION EXPERIMENTS IN NEW JERSEY IN 1903.

By Edward B. Voorhees,
Director New Jersey Agricultural Experiment Stations.

ASPARAGUS, BLACKBERRIES, RASPBERRIES, GOOSEBERRIES, CURRANTS, AND STRAWBERRIES.

The experiments in progress to study the influence of irrigation upon these crops were continued this year, though the records of rainfall and evaporation, as given by the table which follows, show very clearly the reasons why no real advantage was obtained from the work.

Record of evaporation from water tanks at New Brunswick, N. J., July, 1902, to July, 1903.

Dates of reading	Gain (+) or loss (−) of water in tank.	Rainfall.	Loss of water by evaporation.
1902.	*Inches.*	*Inches.*	*Inches.*
July 19	−1.93	0.44	2.37
August 2	+ .55	2.54	1.99
August 16	+1.70	4.51	2.81
August 30	− .15	1.57	1.72
September 13	− .30	1.32	1.62
September 27	+1.95	2.81	.86
October 11	+2.93	5.41	2.49
October 25	+ .80	1.65	.85
November 8	+ .85	1.90	1.05
1903.			
March 7 (started)	--------	--------	--------
March 21	+1.56	2.51	.95
April 4	+1.69	2.97	1.28
April 18	+2.45	3.83	1.38
May 2	−1.90	--------	1.90
May 16	−1.98	.18	2.16
May 30	−2.10	.11	2.21
June 13	+1.60	3.72	2.12
June 27	+1.65	2.87	1.22
July 11	+ .68	1.18	1.86
Total	--------	39.52	30.82

It will be observed from a study of the table that the rainfall exceeded the evaporation during the growing season by 8.70 inches. This is the first year since the tank was established that the evaporation has not exceeded the rainfall. In 1900–1901 the evaporation exceeded the rainfall by 8.66 inches, while in the same period of 1901–2 the evaporation exceeded the rainfall by 1.52 inches. It will be noticed also that the only serious deficiency in rainfall occurred in May. This drought was accompanied by cool weather; hence, while growth was retarded, it was due quite as much to the low temperature as to the lack of water. This was clearly proved by the results obtained in the application of water, particularly in the case of asparagus. This being the earliest crop, the harvest season of which is the latter part of April and the months of May and June, would naturally be more seriously affected by a lack of water and consequently more benefited by its application, other things being equal, than crops coming on later. Nevertheless, it was shown that the application of water did not result in increasing the yield of the crop. Evidently the low temperature prevented a proper growth and development, even with an abundance of water. Water was also applied to blackberries, raspberries, gooseberries, currants, strawberries, and fruit trees; and while the records were faithfully kept, they show that no advantage was derived from the addition of water. This result was also due in large part doubtless to the fact that the growth through May was not retarded by lack of water, but by the low temperature. Inasmuch as the results do not show any particular effect, they are withheld from publication until further data are obtained.

IRRIGATION DURING THE SEASON OF 1903 AT MISSOURI AGRICULTURAL EXPERIMENT STATION.

By H. J. Waters, *Director*.

During the season of 1903 the cooperative experiments in irrigation were continued with strawberries, asparagus, nursery stock (consisting of apple, peach, and plum trees), and onions.

The season taken as a whole may be said to have been favorable for growing crops, although the excess of moisture during the late spring and early summer was a detriment to farm work for a time. The summer was cooler than usual throughout, with the exception of May and July. The first part of April was warmer than usual, but during the latter part of the month the weather was generally cool, with heavy frosts on the 23d and 26th. The mean temperature of the month was 54.9° F., or 1.5° below the normal. The precipitation exceeded the normal by 1.68 inches and was fairly well distributed. The first week of May was unseasonably cool. A killing frost occurred on the first, but the remainder of the month was warm, with frequent showers. The mean temperature was 65°, or 0.5° above the normal. The rainfall was abundant, being slightly above the normal for the month. June was exceptionally cool and dry, the mean temperature (66.4°) being 7.9° below the normal, while there was less than half the usual amount of precipitation. July averaged slightly warmer than usual, the mean temperature being 77.3°, or 0.9° above the normal, while the precipitation was markedly deficient, being 1.91 inches below the normal. August was cool and showery, the mean temperature (73.9°) being 2.1° below the normal, with about double the usual amount of precipitation. The following table gives the precipitation for the season at Columbia, Mo.:

Precipitation, April-August, 1903, at Columbia, Mo.

Day.	April.	May.	June.	July.	August.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1	----------	----------	0.08	----------	0.05
2	----------	----------	.20	Trace.	.10
3	1.39	----------	.06	0.18	----------
4	----------	----------	.09	.02	----------
5	----------	0.28	.06	----------	.01
6	----------	Trace.	----------	----------	.65
7	.03	.01	----------	----------	.01
8	----------	----------	Trace.	----------	.24
9	----------	Trace.	.13	----------	----------
10	.32	Trace.	----------	----------	----------
11	.23	.33	----------	.80	.07
12	Trace.	.04	----------	.01	.58
13	.01	.23	----------	----------	.91
14	.06	.01	----------	01	----------

Precipitation, April-August, 1903, at Columbia, Mo.—Continued.

Day.	April.	May.	June.	July.	August.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
15	Trace.				
16	0.01		0.01	0.13	Trace.
17		0.09		.03	
18	.02	.03		.62	
19	.98	.13	.58		Trace.
20	.70	Trace.			
21		.37	.01	.53	
22			.33	Trace.	
23		.05		.01	
24	.02	.04			Trace.
25		1.96	.02		0.24
26		Trace.	.57		.88
27		.06	.02		.47
28					.88
29	.14	.24		.02	Trace.
30	.75	.28			
31		1.11		Trace.	
Sums	4.66	5.26	2.16	2.36	5.09
Departure from normal	+1.68	+0.31	−2.71	−1.91	+2.57

Irrigation was not begun on any of the crops except onions until August, because showers had been frequent and the soil seemed to be fairly well supplied with moisture.

STRAWBERRIES.

The value of irrigating an old strawberry field having been fully demonstrated heretofore in these tests, this experiment was planned to determine the effects of watering a young plantation of the vines. The plants were set in the spring and given good culture throughout the season until the irrigation began. In a few rows there was a poor stand, owing to some of the plants having been injured in transplanting. Also, this being a partial test of some, a few of the newer varieties planted proved to be weak growers.

The rows were 4 feet apart and the plants as set stood 2 feet apart in the rows. The irrigating ditches were made by opening a furrow beside each row of plants with a single-shovel plow. This plan was favored because the ground sloped gently from near the center toward both sides—the east and the west—as well as toward the south, the direction in which the water was to flow. The furrows being as near the rows as possible and always on the upper sides, no difficulty was experienced in saturating the soil about all of the plants. When the plants had made a good growth the runners had covered nearly all the spaces in the rows between the original plants, and in some parts of the plat there were solid mats of plants as much as a foot wide.

The water used was secured from the city waterworks system, and was conducted through pipes and hose and fed into a trough, from which it was distributed uniformly into six furrows at a time.

Water was first turned into the strawberry field on August 3, and was allowed to flow at intervals for five days. The area irrigated was about one-seventh of an acre, and there was a total of 20,000 gallons of water applied, sufficient to cover the irrigated area to a depth of 5.27 inches.

As soon as possible after irrigating the ground was smoothed down and stirred with a light cultivator. Within a few days after watering there were showers, which appeared to leave the unirrigated soil as wet as that which had been irrigated. It was noticeable later in the month, however, that there was more moisture in the irrigated plats, although it is to be remembered that there was no serious deficiency of moisture at any time during the month where there had been no irrigation. While there were no noticeable differences in the growth and vigor of the plants where irrigated and not irrigated during the remainder of the season, it should not be said at this time that there were no beneficial effects from the watering. It appears that the critical period of the season for the strawberry plant is during the month of August. It is found that if water is applied in August in a dry season a good yield of fruit is secured the next summer, but it remains to be determined whether an abundant supply of water furnished artificially is of more value to the plants than a moderate amount supplied by natural precipitation. In other words, it can not be determined definitely until after the next fruiting season whether it will pay to irrigate in a season of medium or abundant rainfall.

Except for the watering, the irrigated and unirrigated plats were given precisely the same treatment throughout the summer and fall, and all of the plants were mulched alike during the winter.

ASPARAGUS.

A part of the asparagus bed mentioned elsewhere in this report was irrigated during the season of 1903. Two rows were selected to be watered. These rows represented average conditions throughout the field. The soil was in good tilth and in splendid condition for retaining moisture, having received each fall for three or four years a heavy dressing of composted barnyard manure, which was worked into the soil by the spring cultivations. The plants were 7 years old and were in prime condition as to vigor. The rows were 4½ feet apart, and the plants were growing thickly in the rows in a mass 12 to 16 inches wide. The land slopes gently toward the south. Furrows around each row were made with a single-shovel plow, working as near the plants as possible without injuring them. At the upper end of the rows a cross ditch was provided for feeding the furrows. The water was allowed to flow in the furrows until the soil was thoroughly saturated. The total amount of water applied to the asparagus during the two days August 10–12 was 2,200 gallons, amounting to a depth of 2.39 inches over the area irrigated, about one thirty-sixth of an acre.

Frequent showers came after irrigating, so that it was not thought necessary to apply any more water. Although the rains kept the soil supplied with more than the normal amount of moisture during the remainder of the month, as well as in September, the irrigated rows showed the beneficial effects of the extra water they had received. Within two weeks after being irrigated, even in the presence of heavy showers which seemed to wet the ground thoroughly, the artificially watered rows began to show signs of being reinvigorated. New shoots began to appear among the old stocks, and the branches of the mature plants showed new activity by appearing green at the tip of every branchlet. In marked contrast to the irrigated plat, the unirrigated rows began to show the usual signs of closing the season's growth by the gradual dying of the inner branches. With the waning of September the brownish appearance was quite noticeable, while the irrigated plants continued green.

Upon closer examination it was discovered that the unirrigated rows were affected with asparagus rust (*Puccinia asparagi*), while the irrigated plants were entirely free from the disease. This was to be expected, as observations recorded by a number of investigators have shown that rust is most destructive in seasons and soils where the plants suffer for moisture. On the other hand, any condition producing too great an amount of moisture about the plants is injurious to them, since the rust is likely to injure plants weakened by excess of moisture as well as by too little.

It is well known that asparagus requires a moist soil for its best development; but the advice of recognized authorities has usually been against late summer or early fall mulching to conserve the moisture, as such treatment was believed to favor the appearance of the rust. That the disease is not aggravated by irrigating in late summer is thoroughly proved by the test just completed. A careful estimate of the extent of the rust disease among the irrigated plants places it at one-half of 1 per cent. An inspection of the unirrigated rows showed that fully 90 per cent of the stems of the plants had died, probably from the effects of the rust.

In Plate II, figure 2, is shown the difference in size and appearance of the irrigated asparagus plants and those not irrigated, the stalks on the left being only average specimens in point of size and are free from disease. The group of small plants on the right was not irrigated. They were not only small, but were badly affected with rust. Plate III, figure 1, shows a near view of sections of some of the asparagus stalks seen in Plate II, figure 2. Those on the left were small, and the disease was very noticeable, as indicated by the blotches and irregularities in the bark. The stalks on the right were irrigated, and were large, clean, and healthy.

When the soil is deficient in moisture, late summer application of water to asparagus will invigorate it sufficiently to cause it to resist rust and enable the root stalks to store up a surplus supply of food materials that will enable them to push up the young edible shoots quite early in the spring that will be both vigorous and abundant.

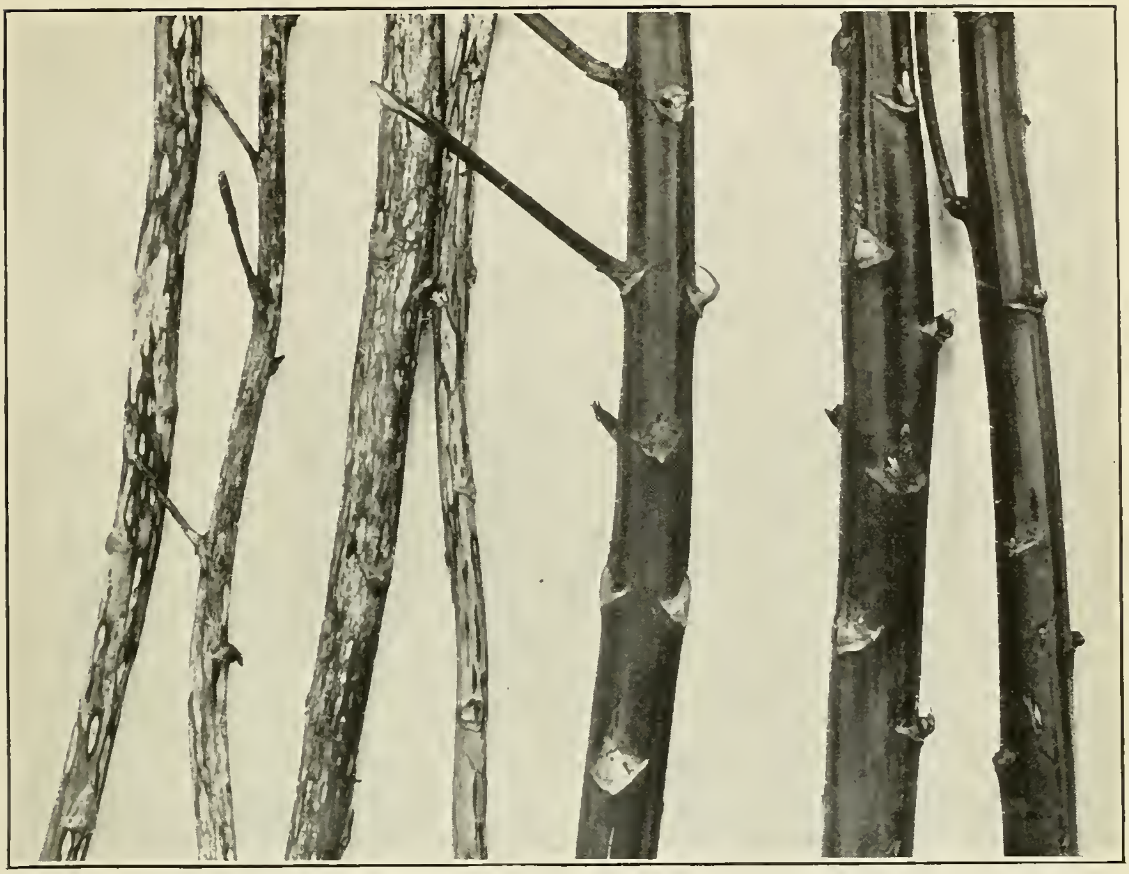

FIG. 1.—EFFECT OF IRRIGATION ON ASPARAGUS DURING AN ORDINARY SEASON; UNIRRIGATED STALKS (ON LEFT) BADLY AFFECTED BY RUST.

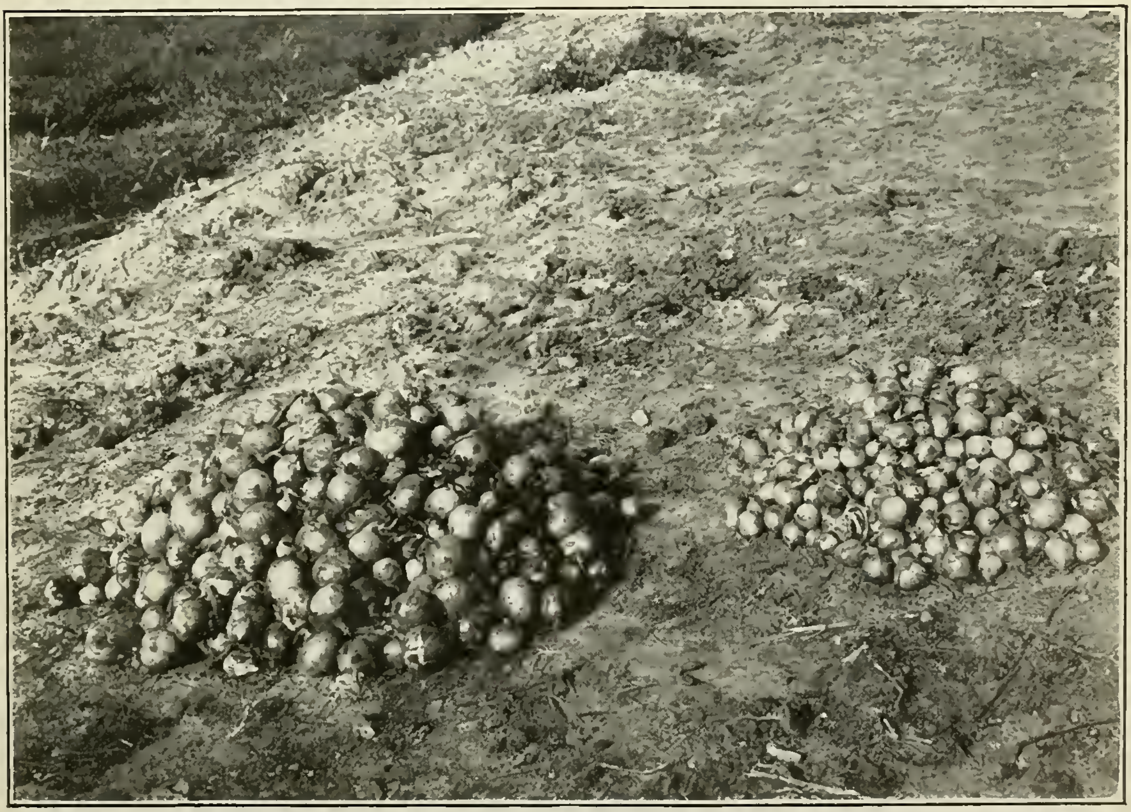

FIG. 2.—YIELDS OF ONIONS ON IRRIGATED PLAT (ON LEFT) AND ON UNIRRIGATED PLAT (ON RIGHT).

NURSERY STOCK.

The nursery stock irrigated during the season of 1903 consisted of 2-year-old apple trees of many varieties, and seedling peach, cherry, and plum trees grown as stocks for budding.

Water was applied from August 7 to 11. With a single-shovel plow furrows were made around each row as near the trees as possible. The irrigated plat was laid off in the middle part of the nursery and represented average conditions in every respect. The water was conducted to the plat through pipes and discharged into a cross ditch at the upper ends of the rows. From the cross ditch the water was emptied into the various furrows uniformly, so that all were equally watered and none overflowed. No water was wasted. The soil was saturated.

The total quantity of water used on the one-tenth of an acre irrigated was 12,400 gallons, equivalent to a depth of 4.67 inches.

Rains came shortly after the irrigating was done, and apparently minimized its results. There is perhaps a slight tendency on the part of the trees irrigated to continue their growth later in the season, thus showing that they have been influenced to at least a slight extent. November 2 the irrigated trees were not appreciably larger than those not irrigated; but as the irrigated ones seem disposed to continue their growth, they may yet outstrip the unirrigated. Nursery trees here may continue to grow until December if they have sufficient moisture.

ONIONS.

Four varieties of onions were experimented with. The soil was a deep, unusually fertile clay loam. The seed was planted May 7 in drills 16 inches apart. The young plants received careful cultivation all during the season. The month of July was the driest and warmest of the season. The land sloped gently toward the south. Shallow irrigating ditches, about 3 inches deep, were made by using the corner of a common garden hoe. There was one furrow down the middle of each space between the rows, making them 16 inches apart. At the upper ends of the rows was a cross ditch, and from this water was fed out uniformly to several furrows at a time. The block to be irrigated was laid off near the middle of the garden, part of the onion planting being left unirrigated for purposes of comparison. The water was conducted over the unirrigated plat through pipes and hose, so that there was no opportunity for seepage into the wrong plat.

The irrigating was begun July 27, the water being allowed to flow until the soil was well saturated. A total of 2,500 gallons was applied, amounting to a depth of 6 inches over the area irrigated—about one-sixty-fourth of an acre. When the water had settled the soil was stirred to prevent baking.

The crop was harvested the first of September, and a careful record kept of the yields under different conditions. There were equal areas in the irrigated and unirrigated plats. Each variety on being harvested was weighed, so as to show the total yield both under irrigation and where not irrigated, and then the product was divided into three grades, where the bulbs were large enough to make this possible. In this way were secured the actual comparative effects of the watering, as shown in the accompanying tables:

Effects of irrigation on size of onions.

Variety.	Treatment.	Large.		Medium.		Small.		All grades.	
		Weight.	Number per pound.	Weight.	Number per pound.	Weight.	Number per pound.	Weight.	Number per pound.
		Lbs. ozs.		*Lbs. ozs.*		*Lbs. ozs.*		*Lbs. ozs.*	
Silver King	Irrigated	7 10	4	7 12	10	11 6	25	26 0	12
	Not irrigated	4 10	7	4 10	11	6 2	28	15 6	14
White Portugal	Irrigated	16 2	5	20 8	9	14 8	26	51 2	14
	Not irrigated	12 6	6	12 8	9	13 8	26	38 4	13
Red Wethersfield.	Irrigated	20 8	5	20 8	7	10 10	17	51 10	11
	Not irrigated	16 6	5	20 8	8	20 10	20	57 8	9
Danvers Yellow Globe.	Irrigated	95 0	3	49 8	5	33 6	13	177 6	7
	Not irrigated	29 10	5	48 0	8	28 6	18	106 0	11

Effects of irrigation on yield of onions.

Variety.	Treatment.	Yield.	Value.	Yield per acre due to irrigation.	Percentage of increase due to irrigation.	Value per acre of increase due to irrigation.
		Bushels.		*Bushels.*	*Per cent.*	
Silver King	Irrigated	52.18	$26.09	22.80	77.6	$11.40
	Not irrigated	29.38	14.19			
White Portugal	Irrigated	94.90	47.45	19.27	25.4	12.70
	Not irrigated	75.63	37.82			
Wethersfield	Irrigated	50.06	25.03			
	Not irrigated	56.06	28.03			
Danvers Yellow Globe.	Irrigated	172.00	86.00	69.50	67.60	34.75
	Not irrigated	102.70	51.35			

It is at once apparent that in most cases the yield was materially increased by watering, although in one instance—the Red Wethersfield—the total yield was slightly greater on the unirrigated plat. If this exception is studied, however, it will be seen that, although the total number of pounds was less on the irrigated soil, more small and fewer large onions were produced on the unirrigated soil. In this connection, also, it should be stated that the Wethersfield onion is a variety well known to be drought resistant, and hence would naturally be less influenced by artificial watering than the others:

Yellow Globe, which requires a moist soil, gave a remarkable increase in yield, due to irrigation. (Pl. III, fig. 2.) The test shows that in almost any season onions may be irrigated with large profit to the farmer or gardener.

CORN.

The season of 1903 was not sufficiently dry in the vicinity of Columbia to show any remarkable differences between irrigated and unirrigated crops. The actual irrigation of corn was not begun until August 14. Up to that time moisture conditions had been fairly favorable for the development of the corn crop. From the above date the water was turned on from a ⅞-inch pipe and was allowed to run continuously for two weeks. In nearly every case the irrigated plats gave larger yields than those not irrigated. Computing the yields per acre from the plat yields we find that the irrigated corn produced at the rate of 63.5 bushels of grain and 4,630 pounds of stover per acre, and the unirrigated at the rate of 58.3 bushels of grain and 4,315 pounds of stover per acre. This is a difference of 5.2 bushels of grain and 315 pounds of stover per acre in favor of irrigation. The influence of irrigation upon corn is not limited entirely to the gross yields per acre. The irrigated corn seemed to be better filled and the individual grains were plumper. The irrigated corn was considerably slower in maturing than the unirrigated. The stalks grew taller on the irrigated than on the unirrigated plats. The water used in this experiment was surface water from a pond. It is believed that the results would have been considerably more favorable for the irrigated plats if the irrigation had been started earlier.

IRRIGATION IN THE ARTESIAN BASIN OF SOUTH DAKOTA.

By A. B. CRANE, *Special Agent.*

INTRODUCTION.

The great artesian basin of South Dakota comprises that area in which flowing wells have been obtained by drilling down into the Dakota sandstone formation that underlies almost the entire State. Owing, however, to the greater number of wells and to the ease with which artesian water can be obtained there, the locality comprised in the James River Valley has become more familiarly known as the artesian basin. It is within this area that most of the experiments in irrigation from artesian wells have been conducted.

The eastern limit of the artesian area is a line about 25 miles east of the James River and approximately parallel to it to a few miles south of Mitchell, from which point it bears southeast, following the course of the river to its mouth. West of the James River artesian water can be obtained almost anywhere except at a few points where the elevation does not allow the water to rise to the surface, as in the Wessington Hills or in the Missouri Coteaus east of Gettysburg. Owing to the fact that the portion of the country west of the James River Valley is given over largely to stock raising, the wells there being used entirely for stock purposes, the work in irrigation is restricted to the valley skirting to the east of Wessington Hills before finally bearing off toward the Missouri.

During the period from 1890 to 1894 quite a number of wells were sunk with the intention of using them for irrigation. Their great expense (from $2,500 to $4,000) restricted their construction to a few persons with large means or to corporations. The wells were mostly 6-inch wells, with depths varying from 1,300 feet in the region of Aberdeen to about 500 feet at Yankton. Few of them, however, owing to various circumstances, have ever been used. The lands were placed in the hands of tenants, most of whom knew nothing of irrigation. The work was spasmodic and without any system or knowledge of the use of water. Of course such attempts could result only in financial loss to the original projectors, so they were given up.

Within the last year or two a new system has been adopted—the sinking of small 1¼ to 2 inch wells. These can be sunk much more cheaply, the price ranging from $300 to $650. Resident farmers find it within their means to sink these wells, and many of them are being sunk throughout the basin.

Though at present used for stock and household purposes, great numbers of them have been located with reference to a possible utilization for irrigation purposes if needed in the future. It is to these wells in the hands of the actual owners and users to which we will doubtless have to look for the future development of irrigation rather than to the larger wells owned by the corporations and nonresidents.

As shown on page 44, the annual rainfall of this region has varied during the last eight years (1896–1903) from less than 13 to over 26 inches, the average being about 19 inches. This is sufficient for many crops when favorably distributed, but seasons of drought have been sufficiently frequent to lead to the construction in many localities of reservoirs, canals, etc., for the utilization of the artesian water for irrigation.

An investigation during the season of 1903 shows that during the last few years there has been an abundance of moisture, well distributed and fully sufficient for all the ordinary grain crops; hence many farms with full equipment of well, reservoir, ditches, etc., have not used the water supply at all, many not even cleaning out their ditches for the last six or eight seasons. As a consequence, most of the positive results that have been reported are from small areas devoted to gardens, fruits, orchards, and forests.

Many of the irrigation plants mentioned in the reports of 1895 and 1896 as being in successful operation have been practically abandoned, and no report can be found for them subsequent to those made at that time. Many of the farms have changed hands, some have fallen into the possession of large land companies, and some of the wells have failed. In general, those who have most thoroughly and systematically tried irrigation are the most enthusiastic regarding it, while reasons for the failure of most of those condemning it can be found in the faulty method of operation.

A detailed report of what is now being done in the different counties of the artesian basin follows.

AURORA COUNTY.

The Smith-Jones farm, about 5 miles east of Plankington, formerly owned by J. D. Bartow, has a 3-inch well, 756 feet deep, discharging 150 gallons per minute; a reservoir about 2 acres in area, which can be filled to a depth of 5 feet, and about a half mile of main ditch. Eighty acres of this farm is situated so that it can be put under ditch. Mr. Bartow sold the farm several years ago and reports nothing done since 1895, but previous to that he irrigated 35 acres with decided success. He raised corn, potatoes, and melons in great abundance, and made a great increase in the grain crop by the use of the water. He estimates that the yield of small grain is doubled in ordinary years, while the yields of potatoes and garden crops are even more largely increased. Mr. Bartow gives as the reason the irrigation plant on this farm has fallen into disuse that it has fallen into the hands of tenants, usually men from the East unacquainted with and afraid of irrigation, and who make no effort to use water. His own success while operating the farm leads him to speak very enthusiastically of the possibilities of irrigation in that section.

J. W. Mullen, on section 24, township 105 north, range 66 west, conducted an irrigated garden with success several years ago; but the well has since failed, so irrigation is not practiced at present.

John Davis, on section 12, township 105 north, range 65 west, has a 1¼-inch well, 924 feet deep, flowing about 60 gallons per minute. He has irrigated trees and has been able to grow them successfully where before he could not make them grow. He runs the water direct from the well. Mr. Davis has attempted gardening with varying success. His great difficulty arose from the fact that often just after irrigating a heavy storm would come, thus making the soil too wet and injuring the crops. A crop of watermelons was spoiled in this manner. Mr. Davis intends to arrange ditches so it will be possible to use the well for irrigation when needed, but so far he reports an abundance of moisture for his small grain and no need of the extra water except for his trees and garden.

Mr. C. L. Mott, on section 15, township 105 north, range 64 west, 14 miles north of Plankington, is conducting a farm which, though not irrigated, strictly speaking, is, to a certain degree, receiving the same benefits. He has three wells on his farm, all 2-inch wells at the surface, finished below with 1¼-inch pipe. They are 840 feet deep and flow, respectively, 100, 72, and 15 gallons per minute. Mr. Mott is developing an orchard. He has 15 acres of 2 and 3 year old trees just beginning to bear, and 6 acres more set out this year. The orchard contains apples, plums, cherries, pears, and peaches, the last two being experiments, but he thinks they are going to succeed, especially the pears. Mr. Mott does not apply water directly to his land, but he has ditches and pools filled with water, and the seepage and the evaporation seem to fully supply the deficiency in the natural moisture. The wells are finely located for irrigation, and if a series of dry seasons occur he intends to use the water directly, if necessary.

A. D. Dougan, living on section 21, township 104 north, range 63 west, 8 miles northeast of Plankington, has a 4½-inch well, 523 feet deep, which flows about 80 gallons per minute. He has a natural lake bed on his land from which he can irrigate about 30 acres. He irrigates his orchard and garden from the well, and is having good success with his trees, though they are still young and have just begun to bear. Mr. Dougan has been well pleased with his irrigation of potatoes, having raised 230 bushels per acre. He has never used the water on small grain, and did not use it at all this season, as there was plenty of rain.

Many farmers in this county having small wells for stock purposes water their home gardens, and town residents having access to hydrants use water on their gardens and lawns, thus raising good gardens, trees, and shrubbery much more successfully than without the water.

BRULE COUNTY.

During the years from 1891 to 1895 Brule County entered quite extensively into the sinking of wells and the construction of ditches, the county and townships undertaking the work with a view to renting water. The wells were not utilized to any extent, and, the seasons having been more propitious, they are now used merely to supply lakes and furnish water for stock.

W. A. Carpenter, on his ranch at Pukwana, began irrigating in 1894–95, using water on small grain; but the price being low and the seasons being favorable he found that under the method of hiring his work done he could not conduct the business on the large scale he had planned without financial loss, so he abandoned operations.

J. M. Green and H. L. Wilrodt, living 12 miles south of Pukwana, have also ceased to use their water except for trees and gardens.

R. F. Jones, on section 5, township 105 north, range 67 west, has a 3-inch well about 600 feet deep, furnishing about 50 gallons per minute. He stores his surplus in a reservoir and irrigates alfalfa, receiving a large yield each season.

BEADLE COUNTY.

Beadle County was one of the few in which townships undertook the sinking of wells, Bonilla and Richland townships each having sunk them with the intention of using them for irrigation. The Richland township well, located on section 29, township 110 north, range 60 west, 4 miles south of Cavour, is a 6-inch well 930 feet deep, and the official test at the time of its acceptance by the township authorities showed a flow of 876 gallons per minute. The well is admirably located upon a high point, and water can be carried in all directions. A large ditch runs south for 1½ miles, and another running north about the same distance has been contemplated but is not yet constructed.

Part of this ditch is 20 feet wide and is intended for storage purposes in lieu of a reservoir. The method of disposing of water from this well was to contract with different individuals for the whole flow for one day each week throughout the season. The charge for the most successful season was $35. The next year each of the seven days was contracted for at $50 for the season, but dissatisfaction on the part of some who wanted water at a lower price than those who gave $50 created dissension, the personnel of the township board was changed, and many of those who contracted did not use the water. This was in 1896; nothing has been done since. The water now runs into a natural lake bed and thence to a neighboring creek. The cost of this well was $3,500, and of the ditches about $250.

The ditches are located so that about ten quarter sections can receive water. There appears to be a good natural reservoir here which would hold all the winter's flow, rendering it available for the next summer, though a few cuts, possibly 10 feet deep, would be needed to carry the outflow to some of the land. By this means at least two additional sections could be irrigated from this well. All those who formerly used water from this well have since sold out and moved away. The man who most successfully used water was Mr. M. O. Bessernd, who reported yields during the two years he used the water, as follows: Wheat, 30 to 32 bushels per acre; onions, 250 bushels per acre; oats, 60 to 90 bushels per acre; and large amounts of garden vegetables; this, too, in a dry year (1895) when the unwatered crops were almost a failure. He was well pleased with his results, and made this statement at the close of his report to the State engineer of irrigation: "I am more than pleased with the results of my first year's irrigating, and will never again be caught at dry farming when water can be had."

The wells in Bonilla township (township 113 north, range 64 west), though intended for irrigation, have never been used except to flood the pasture land and so increase the feed. No one seems to care to attempt farming by irrigation from them.

The most successful irrigators in Beadle County are the Joy Brothers, who operate a large market garden near Huron. Their land is located on section 18, township 110 north, range 61 west, 2 miles south of Huron. They have a 3-inch well 825 feet deep, which furnishes about 150 gallons per minute, and have about 100 acres under irrigation. They store water in a reservoir covering about 5 acres, which they can fill to a depth of 4 feet. This is used on a field of about 30 acres on the river bottom, the main gardens being irrigated directly from the well. The water is carried through 4-inch tile pipes laid to grade with cemented joints, so that no water is lost. At intervals tees or elbows are put in, a short piece of iron pipe being cemented in, in which a screw plug is placed. Water is let out when wanted by removing this plug and is carried in open ditches to the place of use. This pipe cost about 10 cents a foot placed, and Mr. Joy says it is one of the most paying investments on the farm. It was laid in the old open ditch and mounded over about 2 feet deep, the ridges forming paths through the fields.

The cost of applying water to the land—that is, the labor of distributing it—is about $1.25 per acre per year. The cost of ditching is merely nominal, as a plow furrow in the proper direction is all that is needed. Joy Brothers have conducted this garden since 1896 and have met and overcome many of the difficulties which others have experienced. They are careful not to use too much water and so drown out the crop; they let no water stand on the land, but keep it running till it is all soaked in; they use manure freely; they cultivate soon after irrigating. Crops from this garden average about $200 per acre, though Mr. Joy could make no detailed report on the separate varieties. Potatoes yield about 200 bushels per acre; cabbage, 5,000 to 7,000 heads per acre; onions, 300 bushels per acre, and strawberries, 200 bushels per acre. They raise no small grain under irrigation, but grow corn on ground which has been irrigated the previous year, drawing upon the subsoil moisture, which is sufficient for the crop, and in this way the yield is nearly double that of corn not irrigated. They are troubled somewhat with seepage from their reservoir for a few rods around it and are going to try the experiment of sowing alfalfa on the land affected and thus perhaps reclaim it. Two men give personal attention to the garden, giving it their entire time, and employing additional help according to the season and its attendant work.

The Risdon well, famous as being one of the largest and strongest in the basin, is located on section 32, township 111 north, range 61 west, about 2 miles northeast of Huron. Though not used, having been in litigation for years, it is worthy of mention because of its great possibilities. It is an 8-inch well finished with 6-inch casing below, is 935 feet deep, and originally flowed 2,250 gallons per minute. The well was used for power purposes at one time, generating electricity for the city of Huron. At that time it was shut off during the day and opened at night. This resulted in its clogging and losing part of its flow, and it was abandoned for that purpose. It stands now partly closed, flowing off into pastures, where it forms pools where the cattle may drink. This well is admirably located for irrigation purposes. The greater part of a half section on the uplands is capable of being brought under ditch directly from the well, while the lowlands of the James River Valley lie about 100 rods to the east, where all the water could be utilized. A fine natural reservoir site is formed by a large ravine about 60 rods from the well, where an embankment, with a length of perhaps 20 rods, could be made to retain water to a depth of 20 feet. This ravine is accessible for a reservoir back for nearly half a mile, where an embankment is already formed across it by the roadbed of the Great Northern Railway. This reservoir site overlooks the James River Valley land, and the water could be carried down along the bluffs for any distance to the land below, so that the entire winter's flow could be stored and utilized. There is opportunity for a great irrigation enterprise here, one of the best in the whole James River Basin.

Mr. C. M. Bell has a farm half a mile north of Huron equipped for irrigation, having a 3-inch well 760 feet deep, flowing 120 gallons per minute. He has a storage canal 36 rods long and 20 feet wide, which can be filled about 4 feet deep. The water has not been used this year except for a few trees. A large garden was successfully operated in 1902, though no specific data could be obtained. Nearly the entire quarter section can be brought under ditch from this well, as well as many acres on adjoining farms.

R. D. Wharton, in the south part of the city of Huron, operates a market garden of 15 acres, irrigated by means of pipe attached to the city hydrant. He has a system of pipes lying on the ground with valves every 50 feet, to which he can attach hose. He lays his pipe line along a ridge on the upper edge of a field, connects with the hydrant by means of a short hose, and carries the water without loss direct to that part he wishes to irrigate. Mr. Wharton emphasizes the fact, also brought out by Joy Brothers, that the aim should be to supplement the natural rainfall when necessary, but one must be careful about making the land too wet. Often he does not have to irrigate certain portions of his garden at all during the season, the natural rainfall and subsoil waters left from the previous year's irrigation being sufficient. The garden has yielded 250 bushels of onions per acre, 1,000 bushels of carrots per acre, 7,000 to 9,000 head of cabbages per acre, $600 worth of celery per acre, and $125 worth of muskmelons from five-sixteenths acre. All other garden crops yield in equal abundance. He estimates an average income of $150 per acre from his garden.

One of the most extensive systems of irrigation in Beadle County was started about 8 miles north of Huron on section 30, township 112 north, range 61 west, by the Consolidated Land and Irrigation Company of Huron. It had a 6-inch well 916 feet deep, flowing about 500 gallons per minute, and a reservoir of about 7 acres, which could be filled to a depth of 6 feet or more. Several miles of ditch, and a storage canal on the next section east were constructed, and the farm systematically worked for a few seasons (1891–92). Good results were obtained, the crops being more than double those of the unirrigated lands in that locality. The farm, however, established for speculative purposes, has changed hands several times and was without a tenant some years. At present it is lying idle, only needing intelligent management to make it one of the best paying farms in the vicinity. Seepage has spoiled some of the land contiguous to the reservoir, but by proper management the ground can easily be reclaimed.

E. D. Fuller, living 4 miles south of Cavour, on section 23, township 110 north, range 60, is one of the latest to begin irrigation in this county. He has a 2-inch well 772 feet deep, flowing 82 gallons per minute, dug in June this year (1903). His well is located with reference to use for irrigation, and he carried water this season into a 15-acre field of corn, though not in as systematic a manner as he wished. A measurement of stalks which received water compared with some in the same field to which water was not carried showed the former to be 2½ feet taller and much more thrifty looking. His garden was watered also and has proved much more fruitful than it otherwise would have been. Mr. Fuller irrigates direct from the well. He has about 75 acres he can put under the ditch.

There have been several other irrigation plants in Beadle County which have been abandoned because of change of owners or the clogging of the wells. Many of the smaller 1¼-inch and 2-inch wells have been sunk recently for stock watering, though several are also planned to be used for irrigation if necessary.

DAVISON COUNTY.

The Hatch Brothers, on section 15, township 103 north, range 62 west, adjoining the village of Mount Vernon, have two 2-inch wells about 400 feet deep, which flow about 60 gallons per minute. Each well is equipped with a reservoir, and over 100 acres can be brought under the water. These wells were dug about 1897 and during the next two years they were used to irrigate trees, potatoes, and garden. Since then they have not been used, as the rainfall has been greater and seemed adequate.

John K. Johnson and his brother, Joseph K. Johnson, living on sections 3 and 4, township 103 north, range 62 west, also have wells with reservoirs, though they have not used them for irrigation for two years. Joseph irrigates only a small orchard and home garden. John Johnson has experimented quite largely in small grain and gives a very satisfactory report of his success. He has raised, per acre, 27 bushels of wheat, when unirrigated wheat yielded 10 bushels; 60 bushels of oats, when unirrigated oats yielded 30 bushels, and 60 bushels of corn, when unirrigated corn yielded nothing. Mr. Johnson has two wells, one 4½-inch, 650 feet deep, flowing 375 gallons per minute, and one 2-inch well, 411 feet deep, flowing 10 gallons per minute. He has a reservoir of about 7 acres, which is very shallow, and the excessive seepage from it has spoiled some land near it. He can run water upon a whole section and has over 2 miles of main ditch.

Ira Frazier, on section 27, township 104 north, range 61 west, about 12 miles northeast of Mitchell, has a 4-inch well and small reservoir. He also irrigates small grain by flooding his land in the fall and winter, though he does no systematic work. Though his crops are reported as better where the water has been allowed to run than where not, he can give no specific report of advantages. Mr. Frazier made the mistake one season of letting the water flood his land all winter, piling up ice in some places. The result was that in the spring he could not get on his ground until very late, and the soil was so wet and cold his grain did not germinate readily, and his crop was poorer than without the water. The next year, however, this land yielded well.

Nick Reimers, on section 21, township 103 north, range 61 west, 6 miles west of Mitchell, has a 2-inch well, 300 feet deep, flowing about 15 gallons per minute. From this small well he irrigates 8 acres of market garden. He can carry the water to 20 acres, but can not attend to it all. Mr. Reimers raises large quantities of vegetables of all kinds for the local market in the city of Mitchell. He has no reservoir, but runs ditches direct from the well to the land. He reports his land as bringing him $100 or more per acre.

JERAULD COUNTY.

The greater part of Jerauld County is so high that wells can not be obtained, but the eastern part, occupied by the valley of Firesteel Creek, is located very favorably for irrigation, and a well can be secured almost anywhere. Though the rainfall seems to be less than farther east, little is done in irrigation, as stock raising forms the chief occupation of the people.

Charles Walters, 9 miles southeast of Wessington Springs, on section 15, township 106 north, range 64 west, has a 3-inch well, 816 feet deep, which flows 300 gallons per minute. He irrigates from 150 to 200 acres of small grain and corn. His plan is to plant about 40 acres of corn and irrigate it well. The next year he sows this to small grain without irrigation and plants another 40 acres to corn and irrigates it. He carries the water direct from the well, his land lying so favorably that a plow furrow will usually carry water where it is wanted. He usually irrigates his small-grain fields in the fall after plowing, giving them a good soaking so as to be ready for spring sowing. He is careful, however, to let no water stand and freeze on his land, and so render it cold and soggy for spring work. Mr. Walters notes three points of advantage in irrigation, namely: His crop is nearly doubled, his crop is sure, and his grain is first grade. He states that since he has used his well he has had nothing but No. 1 wheat, while his oats and other grain always overrun regulation weight. Mr. Walters has no trouble in carrying water the entire length of his field, about three-fourths mile. He has a fine grove which he started with irrigation, but uses no water in it at present.

Peter Schultz, 7 miles southeast of Wessington Springs, on section 9, township 106 north, range 64 west, has a 2½-inch well, 880 feet deep, which flows 280 gallons per minute. He irrigates a garden and orchard, though at present he uses no water in the latter, since it lies just below his garden and receives sufficient moisture by seepage from the garden. His orchard looks very thrifty. Fifty trees bore fruit of excellent quality in 1903.

Henry Allen, working the northeast quarter of section 6, township 106 north, range 63, has a 3-inch well, 782 feet deep. He irrigates small grain only, by flooding in the previous fall. He estimates that his crop is double what his neighbors get without irrigation.

William Kline, 3 miles north of Wessington Springs, on section 25, township 108 north, range 65 west, has a 3-inch well, 963 feet deep, flowing 400 gallons per minute. Thus far Mr. Kline has irrigated only a home garden, but this year he has built a large pond of 15 acres from which he intends to irrigate about 135 acres, putting part of it into alfalfa.

There was formerly another irrigated farm, 10 miles north of Wessington Springs, worked by Charles Le Bau, but the well failed and nothing has been done lately. Another well has been dug this year, and operations will probably be resumed.

KINGSBURY COUNTY.

Only the western eight tiers of sections in Kingsbury County lie in the artesian basin. A number of wells are found in the region, but few of them are used for irrigation.

K. Fingerson, 2 miles west of Esmond, has a 2-inch well, 850 feet deep, flowing 80 gallons per minute. His well was just dug in 1902, but he has irrigated about 35 acres of oats this season (1903) by flooding. His crop, though hurt by a late frost, is still much better than that on his fields that have had no water. He also irrigated a potato field, and reports a fine yield from it. Mr. Fingerson intends to extend his system further next year and bring about 70 acres under ditch, using the water alternately on different portions during different years.

C. L. Spear and E. Gulbronson, 3 miles south of Manchester, each have sunk wells recently and intend to irrigate.

SPINK COUNTY.

The best and most systematic irrigation plant in the whole artesian basin is that of A. J. Glidden, at Hitchcock, on section 33, township 114 north, range 63 west. Mr. Glidden's well is 4½ inches in diameter, 1,150 feet deep, and has a flow of 450 gallons per minute. The well was dug in the winter of 1894–95, and irrigation was commenced the next season. He irrigates from 60 to 80 acres, though he has water enough for 200 acres if he could take care of it. Mr. Glidden supplements his well with a reservoir of about 20 acres, which he can fill 5½ feet deep, and has his land arranged so he can use water direct from the well on part and from the reservoir on the remainder. He has 2 miles of shelter belts, consisting of a double row of forest trees, running through his fields at intervals of about 60 rods. These break the winds and protect his fields from early fall and late spring frosts, which are prevalent in this section. His explanation of this fact is that the moisture rising from the fields, if not blown away by the winds, forms a blanket over the garden, which protects it from the frosts. The shelter belts, breaking the wind, prevent this blanket from blowing away and leaving the field unprotected. Mr. Glidden took $8,000 worth of produce off his farm during the years 1901 and 1902. The year 1903 has been very favorable and will probably give as good results. He gives the most complete statement of yields for the year 1902 of any person interviewed. Eighteen acres of cabbage yielded 95 tons; 3 acres of onions yielded 1,000 bushels; 2 acres of tomatoes yielded 150 bushels ripe and 500 bushels green; 6 acres of potatoes yielded 500 bushels; 2 acres of popcorn yielded 80 bushels; ½ acre of parsnips yielded 200 bushels; ½ acre of carrots yielded 250 bushels; ¼ acre of beets yielded 200 bushels; 2 acres of squash yielded 5 tons (planted with corn); 1 acre of pumpkins yielded 4 tons (planted with corn); 1 acre of smaller truck yielded 900 bushels, at 50 cents per bushel; 10 acres of field corn yielded 300 bushels of sound corn; 25 acres of oats yielded 1,300 bushels; 5 acres of spelt yielded 200 bushels; 10 square rods of strawberries yielded 14 bushels; 200 currant bushes yielded 10 bushels, and 100 gooseberry bushes gave a big yield. Apple, plum, crab apple, and cherry trees are all doing well, many are already bearing, and others developing each year promise finely. Mr. Glidden's farm is an excellent example of what can be done by irrigation intelligently practiced here in the artesian basin.

T. S. Everett and S. S. Budlong each have farms east of Hitchcock, arranged for irrigation, but nothing is being done at present by either of them, as the season was considered favorable for small grain without irrigation. They each report that in ordinary years they have doubled their crop by watering it, that they are always sure of a crop, and that it will be first grade when water is used. The farms are now in the hands of tenants, who know nothing of irrigation and do not care to bother with it. Mr. Everett reports 30 bushels of wheat, 75 bushels of oats, and 40 bushels of corn per acre from his land.

J. M. Miles, of Redfield, irrigates about 15 acres with water from the city hydrant. It is entirely in garden and orchard, and he can irrigate but a small portion each year, as he has but little water. He intends to sink a well on his land and work more systematically soon. He reports large yields of garden vegetables, but nothing in detail except celery, which yields him about 1,000 dozen bunches per acre, which, at 50 cents per dozen, brings him $500.

The H. F. Hunter farm, section 4, township 119 north, range 64 west, and adjoining sections, is equipped with a 6-inch well, 1,065 feet deep, flowing 1,250 gallons per minute. It has a 5-acre reservoir and about 5½ miles of main ditch. The water is not used for 1903, as the season has been so favorable that the moisture remaining in the ground from previous irrigation has proved sufficient for the crops. During the years when this farm was irrigated the yields of small grain were just about double that of unirrigated grain in that locality, while potatoes and garden crops generally were increased threefold or more. It requires the entire time of one man to keep ditches in repair, clean off the grass, and direct the water when irrigating. Two other wells in this vicinity were previously used for irrigation, but they ceased to flow some time ago.

Among the counties in which irrigation has been attempted are

Brown, Charles Mix, and Sanborn, but practically nothing has been done in these for several years. The seasons have been reported as very favorable without additional moisture.

COST OF WELLS.

The cost of digging these artesian wells varies with the size and depth. They are constructed much cheaper at present than at the time the larger wells were dug. In 1891–1895 a 6-inch well cost from $2,000 to $3,500. Nearly all the wells dug at present are the smaller sizes—1½, 2, or 3 inches in diameter—and their cost ranges from $400 to $1,000, according to size and depth, the regulation charge being for a 2-inch well (the greater number being that size) about 60 cents per foot.

DUTY OF ARTESIAN WATER.

The most successful irrigators in the artesian basin emphasize the fact that here the need is not to supply all the moisture required for a growing crop, but simply to supplement the rainfall.

The main defect in the rainfall is that it does not always come at the time it is needed. To remedy this condition and to guard against the danger of too much moisture when the rains do come are the problems before the farmer in this section. Experience has proved that it is a very easy matter to get too much water, and that its effect is more disastrous than too little. Owing to the fact that the precipitation is very nearly sufficient to mature the ordinary small-grain crops, the amount of water which would be required for a 40-acre tract in the arid regions would be sufficient for twice or even three times that acreage here. Under proper conditions, with a reservoir for storage purposes, those who have estimated most closely say that a 2-inch well will supply all the water needed on a half section of land, while a 4-inch well would supply a section. This does not mean that the entire half section could be covered each irrigating season, but it has been found that a tract having a thorough irrigation during one season will raise a full crop of small grain the next season with no extra water, for the water already in the soil is sufficient to fully supplement the rainfall.

This method has proved more successful than continued irrigation, as it guards against saturation and its attendant soil deterioration due to the deposit of salts.

METHOD OF IRRIGATING.

The method employed in irrigating varies somewhat with the crop. For small grain the general plan is to plow the field in the fall and then irrigate by flooding, letting the water run until the ground is well moistened, but not long enough to allow water to stand on the field. This leaves the ground so that it can be worked in season and furnishes moisture to germinate the seed. In ordinary years this is sufficient, but in a dry season another watering is given just as the grain is beginning to head. If water is applied much earlier than this the ground, not being sufficiently shaded by the foliage, is apt to bake and form a hard crust over the surface. On the other hand, if watered later it retards the maturing of the grain and impairs its quality.

Several farmers tried the plan of allowing the water to flood their land all winter, letting it flow unrestricted over the fields. This proved detrimental and even disastrous in some cases. The ground became so wet that it could not be worked till late and the soil remained so cold that seed rotted before it could germinate, and the result was a swampy weed patch instead of a field of grain. It is hard for beginners to rid themselves of the idea that if a little water is a good thing more is better; and more irrigators in this section have failed in their efforts and given up entirely from the effects of overirrigation than from any other cause.

Those who have been most successful financially are the market gardeners. Their methods vary with the different crops and seasons. Their aim is to have the ground well moistened at seed time to insure quick germination. After that they simply watch the crop and water when needed. These crops are almost invariably watered by the furrow system, letting the water flow down between the rows of vegetables and seep to the roots. Cultivation within three or four days after irrigation is essential to prevent the ground from baking. The early vegetable crops, as garden peas, beans, radishes, lettuce, etc., are usually grown as quickly as possible and disposed of, the ground being cleared off for another crop of millet or turnips, or utilized to set out late cabbage and tomato plants. In this way two crops are raised on the same land, the irrigation for the first crop being sufficient for maturing the following one.

Fruiting crops, such as strawberries and tomato vines, are watered just as the fruit is beginning to set, unless the rainfall has left the soil in proper condition. Meadows are irrigated by flooding in the spring and after each crop, except the last. This has been found especially favorable for tame grass and alfalfa.

OBJECTIONS TO ARTESIAN IRRIGATION.

Aside from the danger of a rain coming immediately after irrigation making the soil too wet, the chief objection to irrigation by artesian waters is due to a belief that various salts contained in the water poison the soil and render it unfruitful. Special inquiry was made regarding this matter, and those who have used the water in irrigation the most extensively were unanimous in the statement that there were no injurious effects if the water were properly used. The experiences of Joy Brothers and Mr. Glidden agree on this point. They find that water is frequently applied in such excessive amounts that the rootlets are smothered and the soil is covered by standing water which on evaporation leaves a deposit of salts. Hence many conclude that the salts have killed the vegetation, whereas it is the superabundance of water instead. In nine years' experience with proper handling of the water they have found no difficulty nor any indication that there will be any in the future. A complete analysis of the artesian waters from wells in different parts of the artesian basin was made by Prof. J. H. Shepard, of the South Dakota Agricultural Experiment Station, to determine the quantity and nature of the salts and their effects on the soil and vegetation.[a] His conclusions are as follows:

> It is undoubtedly true that the artesian waters of the Dakota Basin do carry large quantities of soluble constituents. The residues from these waters are larger than those of most waters used for irrigation; but when the various climatic conditions of the basin are taken into consideration, and when the drainage and soil conditions of the most favorable kind are considered, it is not unwarrantable to suppose that favorable results may be obtained by an economical and judicious application of the artesian waters. Especially is this true when one remembers that during many years no irrigation at all is desirable. And then again, all parts of the basin are subject to such heavy falls of rain that any accumulating salts must of necessity be washed away. Then again, even in the driest years, the period when crops would be benefited by irrigation is short, so that only a limited application of water would be needed. All these facts would lead one to believe that such irrigation as needed here may be accomplished by artesian waters.

A tabulated statement of Professor Shepard's analyses is given below:

Analyses of the waters from ten typical wells in the artesian basin.

BASES AND ACIDS (parts per 1,000).

Location of well.	Soda, Na_2O.	Lime, CaO.	Magnesia, MgO.	Carbon dioxid, CO_2.	Sulphur trioxid, SO_3.	Chlorin, Cl.
Yankton	0.1384	0.4304	0.1054	0.0548	0.7860	0.0996
Armour	.2046	.5214	.1671	.0684	1.0214	.1745
Woonsocket	.4070	.3120	.1234	.0717	1.0090	.0684
Huron	.3743	.3349	.1421	.0684	.9806	.1240
Iroquois	.9860	.0109	.0168	.1280	.9095	.1575
Hitchcock	.3520	.3737	.1462	.0675	1.0479	.0967
Redfield	.8546	.0478	.0316	.0931	.8841	.1592
Northville	.4102	.4064	.1330	.2455	.4911	.3877
Aberdeen	.8552	.0492	.0386	.0857	.9312	.1443
Westport	1.3004	.0112	.0184	.2561	.2352	.9110

PRINCIPAL SALTS (parts per 1,000).

Location of well.	Sodium chlorid, $NaCl$.	Sodium sulphate, Na_2SO_4.	Sodium carbonate, Na_2CO_3.	Magnesium sulphate, $MgSO_4$.	Magnesium carbonate, $MgCO_3$.	Calcium sulphate, $CaSO_4$.	Calcium carbonate, $CaCO_3$.
Yankton	0.1643	0.1172	....	0.3160	....	0.8700	0.1246
Armour	.2879	.1186	....	.5011	....	1.0550	.1554
Woonsocket	.1128	.7941	....	.3701	....	.5360	.1630
Huron	.2046	.6083	....	.4261	....	.6020	.1554
Iroquois	.2598	1.6153	0.2432	....	0.0353	....	.0195
Hitchcock	.1595	.6120	....	.4384	....	.6989	.1534
Redfield	.2626	1.5701	.0499	....	.0664	....	.0854
Northville	.6396	.1620	....	.3988	....	.2280	.5580
Aberdeen	.2381	1.6538	.0108	....	.0811	....	.0879
Westport	1.5031	.4177	.5475	....	.0386	....	.0200

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[a] South Dakota Sta. Bul. 81.

Analyses of the waters from ten typical wells in the artesian basin—Continued.

SOLUBLE AND INSOLUBLE SALTS (parts per 1,000).

Location of well.	Total salts.	Soluble after evaporation.	Insoluble after evaporation.
Yankton	1.6023	0.5975	1.0048
Armour	2.1392	.9076	1.2316
Woonsocket	2.0088	1.2770	.7318
Huron	2.0334	1.2390	.7944
Iroquois	2.1831	2.1183	.0348
Hitchcock	2.0868	1.2099	.8769
Redfield	2.0546	1.8826	.1720
Northville	2.0380	1.2004	.8376
Aberdeen	2.0909	1.9027	.1882
Westport	2.5501	2.4683	.0818

The results attained upon the experiment station plats at the Hunter farm near Mellette corroborate Professor Shepard's conclusions:

> Some have professed a belief that a continued application of artesian water would result in overloading the soil with soluble salts, detrimental alike to the tilth of the land and to the growth of vegetation. Under the climatic, soil, and drainage conditions prevalent this belief has little foundation, especially if care be used in the application.[a]
>
> If anything is needed in the artesian water it is animal and vegetable organisms. This, however, may be obtained by storing water in a reservoir.[b]

RAINFALL.

Many think that the great number of ponds created by artesian wells will have a tendency to increase the moisture in the air by evaporation and that it will result in more rain and greater frequency of showers, thus giving a better distribution of moisture throughout the growing season, and that this alone will obviate the necessity of irrigation. While occasional light local showers have apparently been produced from the vapor arising from some of these ponds, yet the greater part of the moisture is carried by the winds a long distance, and is precipitated where it does no good to the farmers of this valley. On account of the great fluctuation of the amount of moisture for the last few years it is difficult to determine whether there has been any actual increase due to this cause. At best, though, this would add very little to the rainfall, and the total amount would still be inadequate during periods of ordinary or extra-dry weather.

The fact that the present period of favorable rainfall has been coincident with the filling up of these ponds is undoubtedly the basis of the opinion that the existence of the ponds increases rainfall. The rainfall for the last eight years has been very favorable, both in amount and distribution, as is shown by the following table given for Huron, which is centrally situated and representative of the conditions throughout the valley:

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[a] South Dakota Sta. Bul. 52.

[b] South Dakota Sta. Bul. 28.

Precipitation at Huron, S. Dak., from 1896 to 1903.

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	0.45	2.87	0.01	0.26	0.07	0.13	0.32	0.08
February	.46	.52	.22	.33	.14	.28	.39	.31
March	1.71	1.53	.84	1.13	1.40	.79	1.56	1.02
April	6.17	4.03	2.89	1.04	2.16	.86	1.11	1.26
May	2.95	.46	2.90	2.96	.62	1.78	2.24	1.99
June	5.18	3.81	1.81	2.91	4.00	6.46	3.55	2.54
July	1.62	2.32	3.83	.90	5.59	.64	1.53	1.61
August	1.17	2.69	.46	2.06	6.66	2.50	2.36	1.09
September	2.36	1.14	1.31	.29	2.39	6.75	.19	2.62
October	1.70	2.13	1.01	1.43	1.47	1.11	.76	.34
November	1.97	.67	.23	.16	.17	.08	.29	.37
December	.36	.57	.11	.19	.06	.60	2.12	.60
Total	26.10	22.74	15.62	13.66	24.73	21.98	16.42	13.83

While reports from all parts of the valley mention the abundant rainfall, during the more recent years a study of the precipitation records shows that there has been little change in the total precipitation, the very favorable conditions being due more to better distribution than to a greater amount.

CONCLUSIONS.

As a result of this series of investigations the following conclusions are established:

(1) Irrigation can be practiced to advantage during most of the years, though there is occasionally a year when the moisture is sufficient and properly distributed.

(2) The wells are not called upon to furnish all the water needed for crops, but merely to supplement rainfall.

(3) Care must be taken that the soil does not become too wet.

(4) The salts in the waters and those drawn from the land have not thus far had any detrimental effect, nor do they give indications that they will have in the future. All cases of deterioration of the soil are directly traceable to an oversupply of water.

(5) Under irrigation the farmer is practically sure of a crop each year.

(6) In ordinary or extra dry years the crop is increased two and sometimes three fold.

(7) The crops are always of superior quality, grading No. 1 when unirrigated crops grade No. 3 or are even rejected.

(8) A good 2-inch well supplemented by a reservoir will furnish water for a half section of land.

(9) The main drawbacks are the lack of knowledge regarding the practical handling of water in the field and the too lavish application, especially if soon followed by rain.

(10) During the last seven or eight years very little advancement has been made in irrigation farming, but at present farmers are arranging their wells with reference to a probable future use, and when the necessity again arises many will be prepared and will make use of their supply.

In general, those who have not waited for the necessity to arise, but have practiced irrigation as a part of improved and intensified farming, have found it profitable even under the present favorable natural conditions.

O

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 149.

A. C. TRUE, Director.

STUDIES OF THE FOOD OF MAINE LUMBERMEN.

BY

C. D. WOODS,
Director, Maine Agricultural Experiment Station,

AND

E. R. MANSFIELD,
Assistant Chemist, Maine Agricultural Experiment Station.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 149.

A. C. TRUE, Director.

STUDIES OF THE FOOD OF MAINE LUMBERMEN.

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1904.

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E. W. Allen, Ph. D., *Assistant Director and Editor of Experiment Station Record.*
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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., August 15, 1904.

Sir: I have the honor to transmit herewith a report of studies of the food of Maine lumbermen, carried on by Charles D. Woods, director, and E. R. Mansfield, assistant chemist, of the Maine Agricultural Experiment Station, and recommend that it be published as Bulletin No. 149 of this Office.

Five dietary studies and six digestion experiments were carried on in Maine lumber camps while the men were engaged in severe manual labor. The dietary studies are interesting in themselves and of use in the calculation of dietary standards. The digestion experiments afford data regarding the digestibility of a mixed diet and the effect of severe work upon the quantities of nutrients assimilated.

Acknowledgment should be made to Mr. Thomas Gilbert, of Orono, Me., for the opportunity to carry on the investigations in his lumber camps and for other courtesies.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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STUDIES OF THE FOOD OF MAINE LUMBERMEN.

INTRODUCTION.

In the winters of 1901–2 and 1902–3 five dietary studies and six digestion experiments were made of men at work in a typical lumber camp in the Maine woods, situated in the heart of the forest, away from any settlement. Every facility for the successful carrying out of the studies was given by the owner of the lumber property, Mr. Thomas Gilbert, of Orono, and it is believed that the studies here reported are typical of the dietaries of lumbermen in this region. The description of the camp and the surroundings of the men is believed to be typical of the logging camps of the Maine woods where 40 to 60 men are employed.

There has been a gradual change in methods and appliances, but the methods of lumbering in Maine and the management of lumber camps have changed less than in some other regions, the changes in the ways of living being greater than in the lumbering operations themselves. The men are now better fed, better housed, and better paid than formerly. Since the advent of the railroad supplies are more readily obtained, and the improvement in methods of preserving food has made possible in camp many articles that could not formerly be obtained. The demand for labor and the scarcity of men have caused competition not only in wages but also in the food and care of the men while in the woods.

As shown by the results of the food investigations here reported, the diet of the Maine lumbermen consists of a few staple foods, such as bread, salt pork, beans, corned beef, salt fish, some vegetables, a few simple cakes and other pastry, molasses, and tea. Though more generous, it agrees quite closely in character with that observed by Thoreau on his trip to the Maine woods in 1846.[a] "The loggers' fare," he says, "consists of tea, molasses, flour, pork (sometimes beef), and beans. * * * On expeditions it is only hard bread and pork, often raw, slice upon slice, with tea or water as the case may be." At that time cake and such articles were apparently not a part of the lumber camp diet, for, commenting on the great abundance of "sweet cakes" on the tables of public houses near the lumber region,

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[a] The Maine Woods. Boston. 1877. pp. 10. 19. 45.

Thoreau says that "when the lumberers come out from the woods they have a craving for cakes and pies, and such sweet things, which are there almost unknown." Black tea, he further states, is indispensable to the loggers.

THE LUMBER CAMP.

The character of the diet of any family or group is determined by their surroundings, market facilities, and similar factors, and to a marked extent by previously acquired food habits. When the food supply is adequate the amounts which will be consumed are, it is generally conceded, influenced by the kind and amount of work performed more than by any other factor. Such conditions must have a decided bearing upon the diet of a group like that included in the present investigation. Furthermore, the length of time the lumbermen have been in the woods undoubtedly has an effect upon their appetite. At the beginning of the winter the food is more or less novel and seems to be eaten with greater relish than later in the season. Exposure to cold and wet and the hardships which are a necessary part of some of the lumbering operations, it would seem must also exercise an effect upon their appetite and the character and amount of food eaten. In order to judge of the effect of such conditions upon the diet of the Maine lumbermen some statements seem desirable regarding their surroundings, the kind of work involved in the lumbering operations, and the conditions under which it is performed.

The site for the camp (Pl. I, fig. 1) where the men spend their time when not at work, and where their food is prepared and most of the meals are eaten is chiefly determined by its relation to the timber which is to be cut, although it must be close to a water supply, either spring or mountain brook. A complete lumber camp usually consists of the main camp where the men live, the office which is given up to the overseer, clerk, and visitors, the hovel or stable, the blacksmith shop, and the bean hole. The walls or "body" of the main camp are made of long logs notched at the ends and placed horizontally, the spaces between the logs being chinked with sphagnum moss, or sometimes with excelsior if moss can not be conveniently obtained. The roof is made of cedar splits resting on rafters and is covered with tarred paper. The entrances to the buildings are in the end, and the main camp is almost invariably so placed that the main entrance faces the south, and is divided into the men's camp, the cookroom, and the dingle. The men's camp contains the bunks, deacon seats, stoves, water barrel, and general stores. The bunks are arranged in two tiers, one above the other, along both sides of the camp. The bottom of the bunks is made of poles and in the case of the lower tier is a foot or so above the floor. The lower bunks extend from the ground to a height of about 4 feet and the second tier to the roof. The bunks

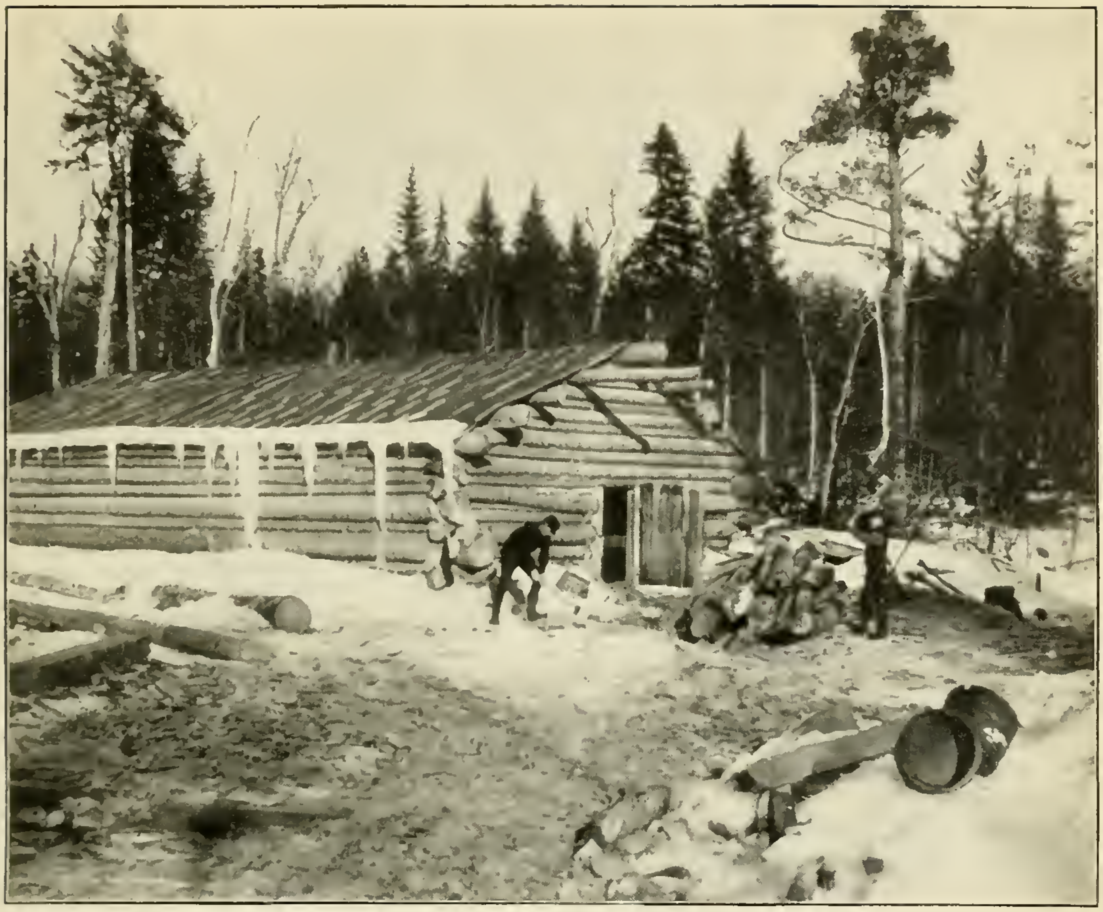

FIG. 1.—THE MEN'S CAMP.

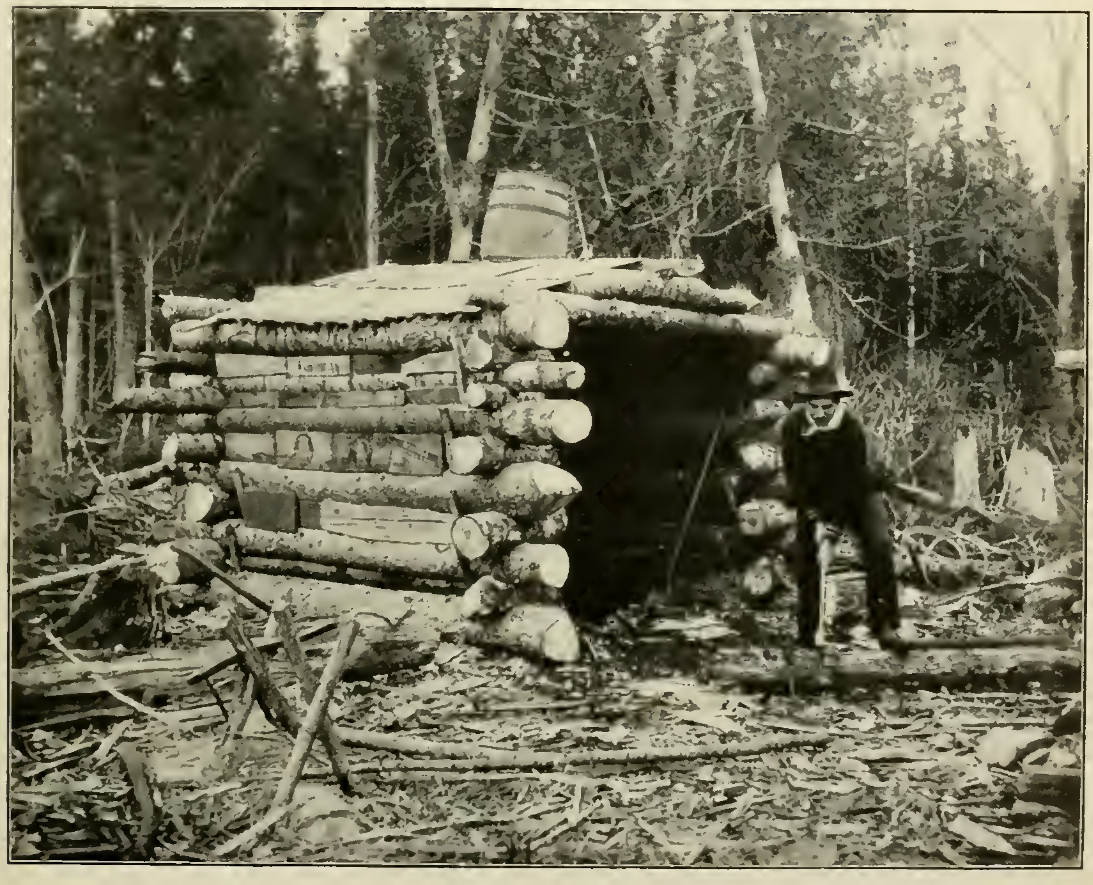

FIG. 2.—THE BEAN HOLE WHERE BEANS ARE COOKED.

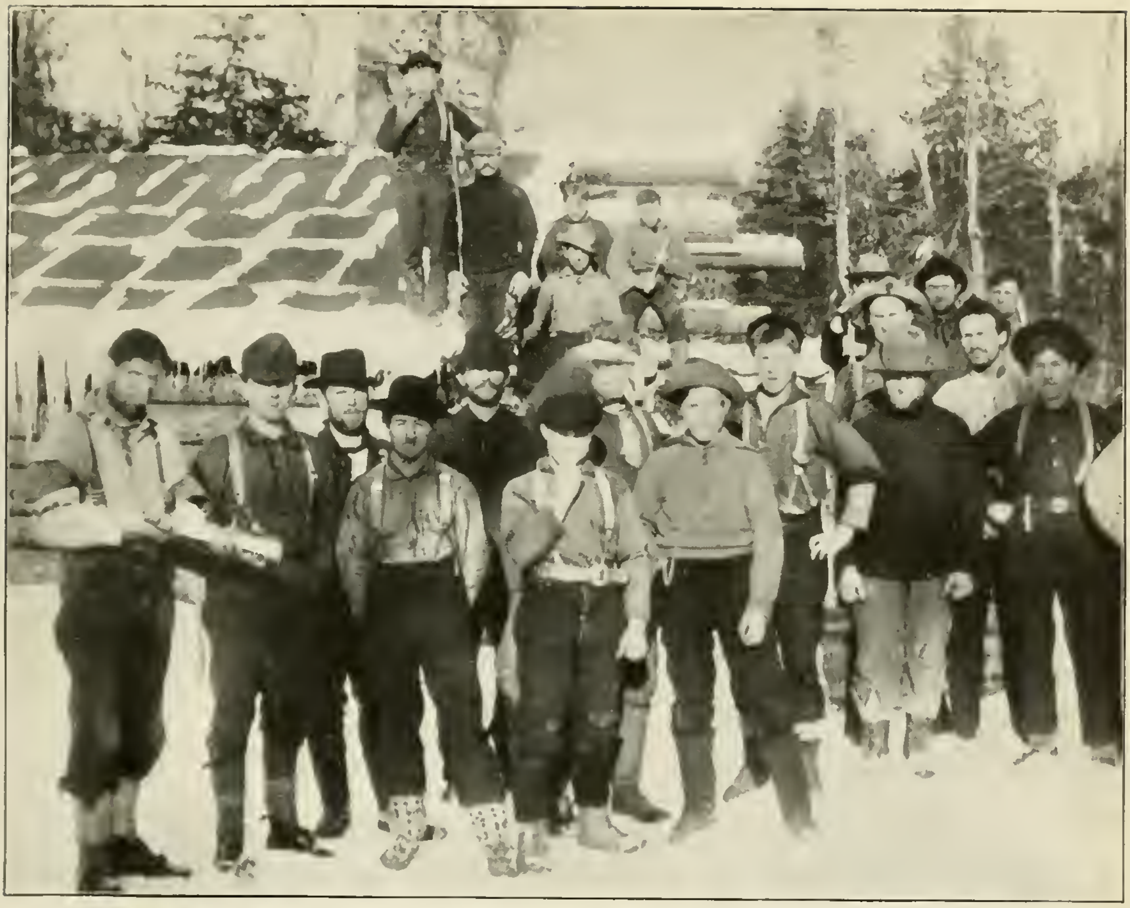

FIG. 1.—A GROUP OF LUMBERMEN STUDIED.

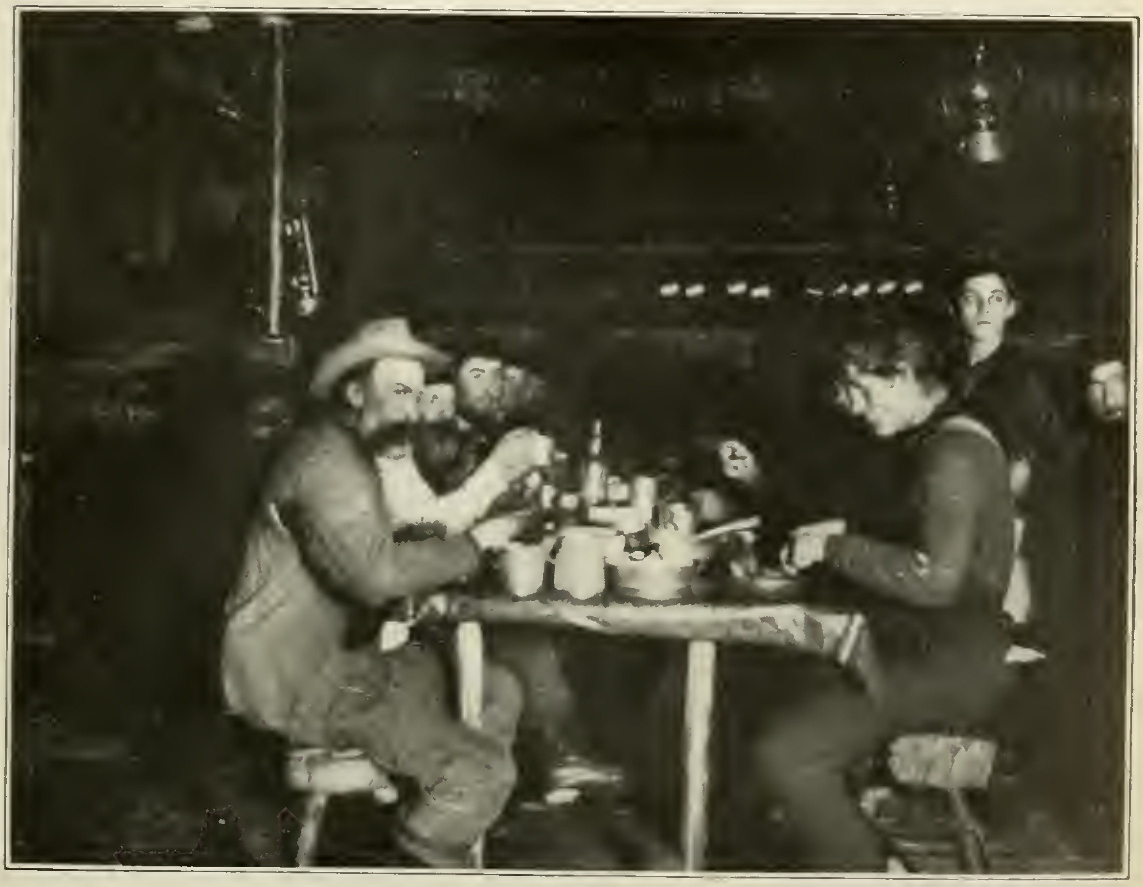

FIG. 2.—LUMBERMEN AT TABLE.

really make a series of wide beds extending the length of the camp. The men sleep with their heads toward the side (wall) of the camp and their feet toward the center. The amount of space per man will naturally vary with the number in the camp. In case of a full camp each man will have a little more than 2 feet. There are no fixed partitions, but the men build them in temporarily, usually two or more men sharing their combined space. The bottom of the bunk is filled with excelsior, boughs, hay, or straw, and above this are placed the two 6-foot blankets, or as they are called "spreads," that are loaned each man. The stoves for the men's camp are of the ordinary box style, and are kept very hot from the time the men come from work at night until they go to bed. The deacon seats are benches made of partially hewn logs placed about 2 feet from the floor and extending the length of the bunks and immediately in front of them. They serve as chairs, but as there is no back to them they are not very comfortable.

A cookroom serves as a combined cooking and eating room (Pl. II, fig. 2). The framework of the table in it is made of poles, and the top of boards. These boards, the cook's bread board and usually some boards from old packing boxes, are the only sawed lumber in a camp. Enameled cloth is used to cover the table. The dishes, chiefly plates and dippers, are all tin, and the knives and forks are steel. Benches made from split logs with stakes for legs serve as seats at table. Breakfast and supper are eaten in the cookroom, but dinner is eaten in the woods when the men are at work.

The cookroom contains small quantities of all the raw materials which are needed for preparing the food and all the necessary equipment of a kitchen, as well as the bunks of the cooks and "cookees," as the cook's assistants are called. As a rule the cooks and cookees are men, for in Maine lumbering operations women cooks have not been at all common, and there are even fewer now than in the past.

The dingle is a lean-to shed adjoining the cookroom, and serves as a sort of storehouse in which all bulky food supplies are kept.

THE BEAN HOLE AND THE METHOD OF COOKING BEANS.

As will be seen by a glance at the kinds of food used in the dietaries, baked beans were the most important single article of diet. The beans are not baked in the cookroom, but in the bean hole, which is simply a hole in the ground protected by a small log building (Pl. I, fig. 2). The beans are parboiled during the forenoon in an ordinary iron kettle on the stove in the cookroom. The bean pot in which they are baked is of iron with an overhanging iron cover, and it is filled with alternate layers of salt pork and parboiled beans. A fire is then built in the bean hole with both soft and hard wood to a depth of 2 feet, and when well under way is covered with stones and old iron, when the covered pot of beans is suspended over the fire. By the time the pot of beans has been heated to the boiling point the fire is burned to coals, and the stones and pieces of iron are red hot. The pot of beans is then placed directly upon these, covered with hot ashes and earth and left to cook overnight, usually twelve to fourteen hours. In the morning the beans come from the hole steaming hot and are served for breakfast.

SOUR-DOUGH BISCUIT.

In the Maine lumber camps cream-of-tartar biscuit are seldom seen, but in place of these the cook makes what are termed sour-dough biscuits. The method of preparing this sour dough is as follows: In the fall of the year, at the beginning of the lumbering operations, flour, water, and lard are mixed to a stiff batter and allowed to remain near the fire from twelve to twenty-four hours. At the end of this time active fermentation (due to wild yeasts) has taken place, and the dough has a very pleasant sour taste and smell. This sour dough is turned on the kneading board and soda and salt are worked into it, after which it is shaped into biscuits and baked. Enough dough is mixed at each baking so that some may be left over to serve as a "starter" in souring the dough for the next baking.

THE LUMBERING OPERATIONS AND THE CHARACTER AND AMOUNT OF WORK INVOLVED.

The work involved in lumbering operations varies at different seasons of the year in character, amount, and conditions under which it is performed. Maine lumbering consists of three distinct operations, viz, cutting and yarding, landing, and driving, each of which involves severe work under more or less trying conditions.

CUTTING AND YARDING, AND LANDING THE LOGS.

In the early part of the season the trees are felled and the logs drawn and put into piles (yarded) near where the trees stood. Cutting and yarding usually begin the last of September or early in October and end in January before the deep snows come. The logs are drawn to the "yards" on single bobsleds.

The overseer or foreman naturally has less physical labor to perform than the men. He looks over the standing timber and surroundings to see where the lumber can best be drawn to the brook or stream where the driving will begin later. He "spots" the main roads and yards and maintains a general superintendence of all the work. The choppers simply fell the trees, top them off, and cut them into logs of the desired length. The "swampers" clear a roadway so that the teams can get from the main woods to the newly cut logs. The sled-tenders limb, knot, and load the logs; the teamsters draw them to the yards, and the yard-tenders build the yards by putting the logs into piles.

After all the logs for the season are cut and yarded they are next drawn on double bobsleds to the landing on the bank of a stream or pond, the operation being designated "landing," for in Maine practically all the logs, whether destined for paper stock or lumber, are taken to the mills by running water in the natural waterways. During landing all the general management is still in the hands of the foreman. The yardmen clear the yards of snow and load the logs in great piles on the double bob or "wagon" sleds. The teamsters draw the logs from the yards to the landing place, and the landing men unload the logs and build the landing. The scaler surveys the logs, and the road crew keep the roads in good condition for hauling. All the operations involve hard work and long hours.

During these operations the crew live at the main camp. The cook builds the fires and does the cooking. The cookees, in addition to helping the cook, carry the dinners to the men where they may happen to be at work. The "toter," as the man is called who hauls in supplies and attends to similar work, makes more or less frequent trips to the nearest supply point; in the case of the camp studied, a railway station.

THE DAILY ROUTINE.

The men work six days a week, Sunday being a day of rest from the regular occupation. On a working day the cook rises at 3.45 o'clock, builds the fires, and cooks breakfast, and at 4.45 calls the "cookees." At 5 o'clock the lumbermen are called, breakfast being served at 5.15. Just as soon as the men can see to follow the road the men and horses start to their work, usually about 6 o'clock. Dinner is served by the "cookees" when the men are at work, anywhere from 11 to 12 o'clock. The dinner "hour" is simply long enough for the men to eat and to fill their pipes. The men leave work when it becomes so dark that they can not longer do the work properly. Supper is usually served at 5.30, and at 9 o'clock the lights are all out and most of the men are in bed.

On Sunday no work is done in the woods and the usual routine is varied. The cook rises at 6.30, the men breakfast at 8, eat their dinner at 12, and their supper at 5.30. The retiring hour is 9 o'clock. Sunday is the wash day of the woodsmen, and from daylight to dark the one washtub and washboard of the men's camp are in constant demand.

DRIVING THE LOGS.

The logs are taken from the woods to the mills in natural waterways, the brooks and streams often forming chains with small lakes, and this operation, perhaps, calls for the greatest physical exertion of any connected with lumbering, while at the same time the work is performed under the most trying conditions, as may be seen from the brief account which follows. About the time the logs are all yarded the spring rains and thaws commence, the streams open, and, the spring freshets insuring an abundance of water, the operation of driving the logs to the mill begins. The logs, which were piled on the shores of the stream during the winter, are now rolled into the stream and the swiftly moving water carries them rapidly along. As they pass down the stream the logs form "wings" along the banks wherever a projection extends into the stream. Very often—in fact, nearly always—this is a help rather than a hindrance, for were it not for the wings that turn the logs toward the center of the stream a jam would soon be formed which would cause considerable difficulty. There are places along the stream where in spite of the wings jams are to be expected, and at these places men are stationed.

Often jams are formed in spite of the efforts of the drivers to keep the center of the stream clear. When a jam is formed which the driver can not break with his cant dog, he resorts to dynamite. It must be remembered that all the while logs are pouring down the stream from above and it is necessary to work quickly. Frequently the breaking of one log may start the whole jam. If possible that log is cut with an ax. Seldom, however, is the log in such a position that an ax can reach it readily. Then one or more sticks of dynamite are attached to the end of a long pole, a fuse is lighted, and the whole thrust into the water in the immediate vicinity of the logs causing the trouble. Occasionally it is necessary to repeat the operation several times before the whole jam is started. Ever since the jam has formed water and logs are backing up and often form a great "head." Of course, the men who work on these jams are in great danger, and it is not a rare occurrence for a limb to be broken or even for a man to be killed, and at all times the work and the strain are severe.

While the logs are being started from the head of the operations, or from where they were left by the lumbermen the winter before, a logging camp is often near enough at hand for the men to stop there, but as moves are made down the stream tenting out is the method of living. After all the logs have been started from the landing it is necessary for a crew to go along the banks of the stream and "break" all the "wings" and start the stray logs; this is known as "sacking the rear." The purpose is to get every log, and in order to do this men are often wet to their hips. It must be remembered that the snow is still on the ground and the water is ice cold.

At the mouth of a stream that flows into a lake, boom chains made of logs chained together at their ends are stretched, and each end is attached to the bank so as to form a big U at the mouth of the stream. When a boom is filled it is closed, and then a crew of men start with it across the lake, moving it forward by means of head-works much as in the days before steam engines a ship was "warped" from point to point.

On the drive the crew get up at 4.15 a. m. and breakfast at 5. First lunch is eaten at 9, second lunch at 2, and supper at 7. In case the men work at night an extra meal is eaten at midnight. The drivers sleep in a large tent and usually go to bed as soon as their supper is eaten. On the drive, as in the woods, two blankets, or "spreads," are loaned each man; but the usual practice is for two men to place one pair under them and the other over them. The men almost invariably sleep with hats on. Only their corked shoes are removed, and even if a man be wet to his neck he goes to bed in this way. During the night his clothes dry, and simply putting on his shoes in the morning prepares him for breakfast and work.

After the first few days of the driving the men seldom stop more than one night in a place and the camp moves forward correspondingly. The moving while "driving" on streams is by teams, but on the lakes boats are used. The move is usually made as soon as first lunch is cooked, and on arriving at the new camping ground the men are fed at the usual hour. There is a tent in which the cook's supplies are kept and the mixing board is placed. In it also the cook and "cookees" sleep.

On the drive no tables are used, but when the food is ready for the men the cook cries "Eat 'er up." A knife and tin plate are seized and each man puts his food upon his plate. The tea, which is always a part of the meal, is poured by the "cookees" and then the men sit down wherever they wish and literally proceed to "eat 'er up." At the first and second lunches the food is brought to the men by the "cookees" and they eat wherever they may happen to be at the time.

THE DIETARY STUDIES.

Three studies of the food eaten by lumbermen at work in the Maine woods were made in the winter and spring of 1901–2, and two additional studies in the winter of 1902–3. The camps of both these winters were located near Lake Onawa in Elliotsville Plantation, Piscataquis County, in the heart of the Maine woods. The camps were about 15 miles from Onawa station on the Canadian Pacific Railroad and about 25 miles from the foot of Moosehead Lake.

The crew in the camps studied was made up almost wholly of French Canadians. The men were for the most part from 25 to 30 years old, of good working weight, generally about 160 pounds, and were an active, rugged set of men at the best age for hard work. On their return to their homes many of them lead a wild life until their winter earnings are gone, but in camp they are strictly temperate and do a full day's work six days in the week.

The men were paid from $26 to $30 per month in addition to their board, the average wages being, perhaps, $28.

Generally speaking, the same men were in at least two of the studies, and many of them were in three or more of them. The initials, birthplace, age, weight, and occupation of the entire crew are given in connection with the report of each study.

All of the details of the work were carried out by one of us (E. R. M.), who lived at the camp with the men during the time of each study. The methods followed in these studies were essentially those explained in a previous publication of this Office[a] and used in the earlier dietary studies.[b]

The general plan included taking an account of all food material in the camp at the beginning, that brought in by the "tote team" during the time of the experiment, and that which remained at the end of the experiment. The cookroom and table wastes were collected, classified so far as possible, weighed, and, together with samples of many of the foods, sent to the Maine station laboratory and analyzed. In every case the amount of a given food material on hand at the beginning and those received during the experiment were added. Whatever was left at the end was subtracted, and the difference showed the amount used. From the statistics thus obtained and the data showing the chemical composition of each material, the amounts of the nutritive ingredients in the food were calculated. The fuel value of the foods was calculated by use of factors,[c] allowing 4 calories for each gram of protein and carbohydrates and 8.9 calories for each gram of fat. The quantities of nutrients and energy in the waste were similarly computed and subtracted from those of the total food to learn the amounts of nutrients in the food actually eaten. An account was kept of the number of persons at each meal, the total number being equivalent to the number of meals for one man.

COMPOSITION OF THE FOOD MATERIALS.

In connection with the dietary studies the chief food materials were analyzed by the methods adopted by the Association of Official Agricultural Chemists,[d] and their heats of combustion were determined by means of the bomb calorimeter. Some of the less important foods were not analyzed, as it was believed that their composition and heats of combustion could be calculated with sufficient accuracy from former analyses of similar articles. The results of the analyses and the figures assumed in the cases of the food materials which were not analyzed are given in Table 1.

The beef (fresh and corned), pork, sausage, salt codfish, fresh fish, eggs, dairy products, and other animal foods, as well as the wheat flour, rice, oatmeal, sirup, and other vegetable foods were of the usual sort offered in Maine markets.

The lard compound was one of the common commercial brands, and probably contained cotton-seed oil with lard and other animal fat.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 21.

[b] See list of bulletins on cover.

[c] See Connecticut Storrs Station Rpt. 1899, p. 104.

[d] U. S. Dept. Agr., Bureau of Chemistry Bul. 46, revised.

The currant jelly and strawberry jelly were commercial glucose products.

The mince-meat, like that commonly used in the lumber camps, was made from dried apples and corned beef.

TABLE 1.—*Percentage composition of food materials in dietary studies of Maine lumbermen.*

Food materials.	Reference number.	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Ash.	Energy per gram.[a]
ANIMAL FOOD.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
Beef:								
Forequarter, medium fat[b]	1	18.7	49.1	14.5	17.5	-----	0.7	2.225
Corned flank[b]	2	12.1	43.7	12.9	29.2	-----	2.6	3.245
Corned, canned	3	-----	56.8	27.4	10.4	0.7	4.7	2.509
Tripe[b]	4	-----	86.5	11.7	1.2	.2	.3	.600
Pork:								
Chuck, salt	5	-----	22.4	4.2	66.3	1.0	6.1	6.124
Backs, dry salted[b]	6	8.1	15.9	7.1	66.8	2.7	-----	6.500
Shoulder, smoked fat[b]	7	20.0	21.4	12.1	42.6	-----	4.2	4.460
Sausage:								
Bologna	8	2.9	63.9	12.6	10.8	4.8	5.0	1.915
Do	9	3.3	64.0	13.9	10.9	4.0	3.9	1.972
Salt pork	10	-----	42.8	7.5	40.1	7.7	1.9	4.535
Fish:								
Cod, salt[b]	11	24.9	40.2	19.0	.4	-----	18.5	.816
Mackerel, pickled[b]	12	19.7	34.8	13.9	21.2	-----	10.4	2.545
Salmon trout, pickled	13	21.2	46.6	16.2	2.8	.6	12.6	1.160
Eggs[b]	14	11.2	65.5	11.9	9.3	-----	.9	1.353
Dairy products:								
Butter[b]	15	-----	8.2	-----	85.9	-----	5.9	7.990
Do	16	-----	8.5	.4	75.2	10.5	5.4	7.233
Milk, condensed[b]	17	-----	26.9	8.8	8.3	54.1	1.9	3.350
Lard compound[b]	18	-----	.2	-----	99.8	-----	-----	9.280
VEGETABLE FOOD.								
Cereals:								
Corn meal[b]	19	-----	12.5	9.2	1.9	75.4	1.0	3.645
Oatmeal[b]	20	-----	7.3	16.1	7.2	67.5	1.9	4.100
Rice[b]	21	-----	12.3	8.0	.3	79.0	.4	3.595
Wheat flour	22	-----	10.8	10.8	1.1	76.7	.6	3.830
Do	23	-----	11.3	11.3	.9	75.7	.8	3.840
Do	24	-----	13.0	9.0	.7	77.0	.3	3.824
Sugars:								
Sugar[b]	25	-----	-----	-----	-----	100.0	-----	4.100
Molasses[b]	26	-----	19.5	-----	-----	80.5	-----	3.305
Do	27	-----	26.5	2.3	-----	68.0	3.2	2.759
Sirup[b]	28	-----	24.7	-----	-----	75.3	-----	3.088
Vegetables:								
Beans, pea	29	-----	11.6	22.8	1.5	60.4	3.7	3.850
Beans	30	-----	13.3	20.4	1.3	61.7	3.3	3.830
Beets[b]	30a	20.0	70.0	1.3	.1	7.7	.9	.380
Cabbage[b]	31	15.0	77.7	1.4	.2	4.8	.9	.275
Carrots[b]	32	20.0	70.6	.9	.2	7.4	.9	.360
Onions[b]	33	10.0	78.9	1.4	.3	8.9	.5	.450
Peas[b]	34	-----	9.5	24.6	1.0	62.0	2.9	3.645
Potatoes[b]	35	20.0	62.6	1.8	.1	14.7	.8	.685
Turnips[b]	36	30.0	62.7	.9	.1	5.7	.6	.275
Fruits:								
Apples, dried[b]	37	-----	28.1	1.6	2.2	66.1	2.0	2.980
Apples, fresh[b]	38	25.1	63.3	.3	.3	10.8	.3	.485
Prunes[b]	39	15.0	19.0	1.8	-----	62.2	2.0	2.620
Raisins[b]	40	10.0	31.1	2.3	3.0	68.5	3.1	3.185
Currant jelly[b]	41	-----	32.5	-----	-----	67.5	-----	2.770
Strawberry jelly[b]	42	-----	17.0	-----	-----	83.0	-----	3.405
MISCELLANEOUS FOOD.								
Mince-meat[b]	43	-----	27.7	6.7	1.4	60.2	4.0	2.875
WASTE.								
Beef, cooked, corned	44	-----	22.7	11.1	62.0	1.2	3.0	6.440
Beans, baked	45	-----	27.1	15.9	10.6	42.6	3.8	3.575
Do	46	-----	59.6	8.1	7.5	21.7	3.1	2.055
Cabbage	47	-----	84.7	1.5	4.1	7.0	2.7	.733
Pudding	48	-----	36.3	3.2	4.4	54.3	1.8	2.853

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[a] When actual determinations were made, this value represents heat of combustion; in other cases calculated fuel value.

[b] Composition assumed.

TABULATION OF RESULTS.

The tabular statements which follow give the results of the dietary studies in condensed form, but they furnish all the original data from which the results were computed. The price which follows each food material shows the cost of the total quantity at the place of purchase (usually Bangor, Me.), and does not take into account the cost of getting the material into the woods and to the camp. The numbers in parentheses refer to food materials in the table of composition and show the analytical data used in the computation of the nutrients supplied.

In calculating the nutrients in the waste, baked beans were classed as vegetable food, although much of the fat present was doubtless of animal origin. The waste was so small in all of the studies that no considerable error is thus introduced.

DIETARY STUDY NO. 390.

The study began with supper December 13, 1901, and continued seven days. The lumber crew were engaged in chopping and yarding. The list of the men included in the study, their occupations, the number of meals eaten, and the weights and costs of foods and nutrients are given in the tables which follow:

TABLE 2.—*Data regarding subjects, dietary study No. 390.*

Name.	Subject of dietary study Nos.—	Place of birth.	Age.	Weight.	Occupation.
			Years.	*Pounds.*	
C. J	390, 391, 392, 393	Maine	56	172	Overseer.
N. G	390, 391, 392	do	27	186	Clerk.
E. R. M	390, 391, 392, 393, 394	do	24	148	Chemist.
W. D	390, 391	Canada	54	172	Cook.
J. M	390, 391	do	18	126	Cookee.
A. R	390	do	25	146	Do.
T. H	390, 391, 392	do	67	215	Blacksmith.
J. T	396, 391	do	54	159	Do.
W. C	390, 393	Maine	48	167	Toter.
M. B	390, 392	Canada	30	148	Chopper.
A. B	390	do	25	159	Do.
J. C	390, 392	do	23	199	Do.
E. F	390, 391, 392, 394	do	24	178	Do.
A. R	390, 391, 392, 393	do	29	162	Do.
E. T	390, 392	do	24	154	Do.
O. B	390, 391, 394	do	26	178	Swamper.
J. C	390, 391	do	22	160	Do.
J. G	390, 391	do	26	164	Do.
J. H	390, 391, 392	do	29	162	Do.
F. K	390, 391	do	25	159	Do.
F. M	390	do	25	154	Do.
J. M	390, 391	do	28	163	Do.
J. M	390	do	24	164	Do.
A. P	390, 391, 392	do	24	159	Do.
M. P	390	do	29	142	Do.
P. P	390, 391	do	27	161	Do.
W. R	390, 392, 394	do	29	174	Do.
F. R	390	do	26	142	Do.
D. R	390, 391	do	23	150	Do.
T. R	390	do	26	159	Do.
J. St. P	390, 391	do	25	159	Do.
C. V	390	do	27	174	Do.
J. C	390, 391, 394	Maine	56		Teamster.
J. D	390, 391, 392	Canada	26	158	Do.
J. P	390, 391, 392	do	26	170	Do.
C. T	390, 391	Maine	57	196	Do.
A. T	390, 391	do	25	147	Do.
C. C	390	Canada	27	179	Sled tender.
M. F	390, 391	Maine	26	180	Do.
C. T	390	Canada	26	159	Do.
E. W	390, 391, 393	do	27	176	Do.
T. D	390	do	23	160	Yard roller.
G. G	390	do	26	160	Do.
F. H	390, 391	do	26	159	Do.
F. S	390	Maine	18	144	Do.
F. St. P	390, 391	Canada	20	159	Do.
T. V	(?)	do	32	125	Do.

The number of meals taken was as follows:

	Meals.
Camp crew:	
Breakfasts	311
Dinners	313
Suppers	312
Visitors:	
Breakfasts	3
Dinners	7
Total number of meals	946

Equivalent to 1 man for 315 days.

TABLE 3.—*Weights and cost of food and nutrients in dietary study No. 390.*

Food consumed during the entire study (7 days.)		Cost, nutrients, and fuel value of food per man per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.						
	Dollars.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Fore quarter, 80 pounds, $5.60 (1); corned flank, 100 pounds, $7 (2)	12.60	4.0	35.3	62.3	--------	695
Pork: Salt, 82 pounds, $8.20 (6); smoked shoulders, 108 pounds, $10.25 (7)	18.46	5.9	27.2	145.2	--------	1,401
Sausage: Bologna, 34.5 pounds, $3.11 (8)	3.11	1.0	6.3	5.4	2.4	83
Fish: Cod, 75.5 pounds, $4.53 (11); mackerel, 115 pounds, $6.90 (12); salmon trout, 6 pounds, 36 cents (13)	11.79	3.7	45.1	35.7	.1	499
Dairy products: Butter, 26 pounds, $4.16 (15); condensed milk, 2 pounds, 15 cents (17)	4.31	1.4	.3	32.4	1.6	296
Lard compound, 75 pounds, $6.75 (18)	6.75	2.1	--------	107.9	--------	950
Total animal food	57.02	18.1	114.2	388.9	4.1	3,935
VEGETABLE FOOD.						
Cereals: Corn meal, 21 pounds, 53 cents (19); oat meal, 1 pound, 3 cents (20); wheat flour, 368 pounds, $7.36 (22)	7.92	2.5	60.3	6.5	430.5	2,021
Sugars: Sugar, 35 pounds, $1.75 (25); molasses, 98 pounds, $2 (26)	3.75	1.2	--------	--------	164.2	656
Vegetables: Beans, 224 pounds, $9.41 (29); onions, 15.5 pounds, 47 cents (33); potatoes, 370 pounds, $4.44 (35); turnips, 24 pounds, 24 cents (36)	14.56	4.6	83.8	5.4	277.4	1,493
Fruit: Apples, 10.5 pounds, 17 cents (38); apples, dried, 20 pounds, $1.80 (37); prunes, 51 pounds, $3.06 (39); raisins, 2.5 pounds, 19 cents (40); currant jelly, 32 pounds, $1.92 (41)	7.14	2.2	1.9	.8	100.0	415
Total vegetable food	33.37	10.5	146.0	12.7	972.1	4,585
Total food	90.39	28.6	260.2	401.6	976.2	8,520
WASTE.						
Beef, corned, 9 pounds (44)	--------	--------	1.4	7.9	.2	77
Beans, baked, 52 pounds (45)	--------	--------	11.9	7.9	31.9	245
Total waste	--------	--------	13.3	15.8	32.1	322
FOOD ACTUALLY EATEN.						
Animal food	--------	18.1	112.8	381.0	3.9	3,858
Vegetable food	--------	10.5	134.1	4.8	940.2	4,340
Total food eaten	--------	28.6	246.9	385.8	944.1	8,198

DIETARY STUDY NO. 391.

The study began with supper January 21, 1902, and continued 16 days. The crew were engaged in drawing the logs from the yards to the landing. The lists of the men included in the study, their occupations, the number of meals eaten, the daily menu, and the weights and costs of foods and nutrients are given in the tables which follow:

TABLE 4.—*Data regarding subjects, dietary study No. 391.*

Name.	Subject of dietary study Nos.—	Place of birth.	Age.	Weight.	Occupation.
			Years.	*Pounds.*	
C. J	390, 391, 392, 333	Maine	56	170	Overseer.
N. G	390, 391, 392	do	27	185	Clerk.
E. R. M	390, 391. 392, 393, 394	do	24	148	Chemist.
W. D	390, 391	Canada	54	179	Cook.
J. M	390, 391	do	18	132	Cookee.
T. H	390, 391, 392	do	67	218	Blacksmith.
J. T	390, 391	do	54	157	Do.
J. D	390, 391. 392	do	26	157	Main road man.
E. F	390, 391, 392, 394	do	24	176	Do.
J. M	390, 391	do	28	163	Do.
A. P	390, 391, 392	do	24	160	Do.
P. P	390, 391	do	27	159	Do.
D. R	390, 391	do	23	150	Do.
O. B	390, 391, 394	do	26	180	Yard man.
J. C	390, 391	do	23	204	Do.
M. F	390, 391	Maine	26	184	Do.
J. G	390, 391	Canada	25	169	Do.
F. K	390, 391	do	25	162	Do.
E. W	390, 391	do	27	176	Do.
J. C	390, 391	Maine	56	147	Teamster.
W. C	390, 391, 393	do	48	172	Do.
J. P	390, 391, 392	Canada	26	178	Do.
C. T	390, 391	Maine	57	199	Do.
A. T	390, 391	do	25	149	Do.
J. C	390, 391	Canada	22	163	Landing man.
F. H	390, 391	do	26	161	Do.
J. H	390, 391, 392	do	29	163	Do.
A. R	390, 391, 392. 393	do	29	164	Do.
J. St. P	390, 391	do	25	149	Do.
F. St. P	390, 391	do	20	164	Do.

Daily menu.

TUESDAY, JANUARY 21, 1902.

Supper.—Fresh-beef smother, mashed potatoes, flour gravy, mashed turnips, loaf bread, butter, molasses cookies, molasses cake, strawberry jelly, tea, sugar.

WEDNESDAY, JANUARY 22.

Breakfast.—Baked beans, biscuit, cold meat, molasses cookies, doughnuts, stewed prunes, butter, tea, sugar.

Dinner.—Baked beans, cold meat, mashed potatoes, mashed turnips, biscuit, butter, sugar cookies, stewed prunes, tea, sugar.

Supper.—Boiled mackerel, cold meat, boiled potatoes, biscuit, loaf bread, butter, sugar cookies, molasses cookies, stewed prunes, strawberry jelly, tea, sugar.

THURSDAY, JANUARY 23.

Breakfast.—Cold meat, biscuit, butter, doughnuts, stewed prunes, mince pie, tea, sugar.

Dinner.—Baked beans, cold meat, biscuit, butter, molasses cookies, sugar cookies, doughnuts, tea.

Supper.—Beef soup, biscuit, butter, molasses cake, sugar cookies, stewed prunes, strawberry jelly, tea, sugar.

FRIDAY, JANUARY 24.

Breakfast.—Beef soup, beans, biscuit, butter, doughnuts, molasses cookies, stewed prunes, apple pie, tea, sugar.

Dinner.—Baked beans, Bologna sausage, cold meat, loaf bread, butter, molasses cookies, sugar cookies, tea.

Supper.—Boiled potatoes, codfish (boiled), biscuit, butter, molasses cookies, sugar cookies, tea, sugar.

SATURDAY, JANUARY 25.

Breakfast.—Baked beans, biscuit, butter, cookies, doughnuts, stewed prunes, strawberry jelly, apple pie, tea, sugar.

Dinner.—Baked beans, cold meat, biscuit, butter, molasses cookies, tea.

Supper.—Boiled potatoes, pork sausage, biscuit, butter, molasses cookies, prune sauce, strawberry jelly, tea, sugar.

SUNDAY, JANUARY 26.

Breakfast.—Baked beans, biscuit, butter, doughnuts, molasses cookies, tea, sugar.

Dinner.—Baked beans, boiled potatoes, cold beef, biscuit, butter, molasses cookies, tea, sugar.

Supper.—Beef soup, biscuit, butter, sugar cookies, doughnuts, stewed prunes, strawberry jelly, tea, sugar.

MONDAY, JANUARY 27.

Breakfast.—Baked beans, beef soup, bread (loaf), butter, doughnuts, molasses cookies, tea, sugar.

Dinner.—Baked beans, brown bread, cold meat, biscuit, butter, molasses cookies, doughnuts, tea.

Supper.—Boiled potatoes, boiled mackerel, biscuit, butter, doughnuts, molasses cookies, currant jelly, stewed prunes, apple pie, tea, sugar.

TUESDAY, JANUARY 28.

Breakfast.—Baked beans, cold meat, biscuit, butter, molasses cookies, doughnuts, tea, sugar.

Dinner.—Baked beans, cold meat, biscuit, butter, molasses cookies, sugar cookies, tea.

Supper.—Boiled potatoes, beef smother, biscuit, butter, molasses cookies, rice.

WEDNESDAY, JANUARY 29.

Breakfast.—Baked beans, biscuit, butter, doughnuts, molasses cookies, tea, apple pie, sugar.

Dinner.—Baked beans, cold meat, biscuit, butter, doughnuts, molasses cookies, tea.

Supper.—Boiled salmon trout, boiled potatoes, biscuit, butter, doughnuts, molasses cookies, stewed prunes, currant jelly, tea.

THURSDAY, JANUARY 30.

Breakfast.—Baked beans, biscuit, butter, doughnuts, molasses cookies, tea.

Dinner.—Baked beans, cold meat, biscuit, butter, doughnuts, molasses cookies, tea.

Supper.—Vegetable soup, biscuit, butter, molasses cookies, doughnuts, sugar cake, tea, sugar.

FRIDAY, JANUARY 31.

Breakfast.—Baked beans, cold meat, biscuit, butter, doughnuts, molasses cookies, tea.

Dinner.—Baked beans, biscuit, butter, doughnuts, molasses cookies, tea.

Supper.—Boiled potatoes, boiled cod, biscuit, butter, doughnuts, molasses cookies, rice, prune sauce, currant jelly, tea, sugar, condensed milk.

SATURDAY, FEBRUARY 1.

Breakfast.—Baked beans, cold meat, biscuit, butter, doughnuts, tea, sugar.

Dinner.—Baked beans, biscuit, butter, sugar cookies, molasses cookies, doughnuts, tea.

Supper.—Beef soup, biscuit, butter, doughnuts, sugar cookies, molasses cookies, prune sauce, currant jelly, tea.

SUNDAY, FEBRUARY 2.

Breakfast.—Baked beans, cold meat, biscuit, butter, doughnuts, molasses cookies, tea.

Dinner.—Baked beans, beef soup, biscuit, butter, doughnuts, molasses cookies, tea, sugar.

Supper.—Pea soup, biscuit, butter, doughnuts, prune sauce, currant jelly, tea, sugar.

MONDAY, FEBRUARY 3.

Breakfast.—Baked beans, Bologna sausage, biscuit, butter, doughnuts, tea, sugar.

Dinner.—Baked beans, Bologna sausage, cold meat, biscuit, butter, doughnuts, tea.

Supper.—Beef soup, biscuit, butter, molasses cookies, apple pie, prune sauce, currant jelly, tea.

TUESDAY, FEBRUARY 4.

Breakfast.—Baked beans, Bologna sausage, biscuit, butter, molasses cookies, stewed prunes, currant jelly, tea, sugar.

Dinner.—Baked beans, cold corned beef, biscuit, butter, sugar cookies, apple pie, prune sauce, currant jelly, tea.

Supper.—Boiled mackerel, cold corned beef, biscuit, butter, sugar cookies, apple pie, prune sauce, currant jelly, tea.

WEDNESDAY, FEBRUARY 5.

Breakfast.—Baked beans, Bologna sausage, biscuit, butter, molasses cookies, doughnuts, apple pie, stewed prunes, currant jelly, tea.

Dinner.—Baked beans, Bologna sausage, biscuit, butter, molasses cookies, tea.

Supper.—Beef soup, biscuit, butter, sugar cookies, sugar cake, tea.

THURSDAY, FEBRUARY 6.

Breakfast.—Baked beans, cold corned beef, biscuit, butter, molasses cookies, doughnuts, tea, sugar.

Dinner.—Baked beans, Bologna sausage, biscuit, butter, sugar cookies, doughnuts, tea.

The number of meals taken was as follows:

	Meals.
Camp crew:	
Breakfasts	491
Dinners	482
Suppers	492
Visitors:	
Dinners	10
Total number of meals	1,475

Equivalent to 1 man for 492 days.

TABLE 5.—*Weights and cost of food and nutrients in dietary study No. 391.*

Food consumed during the entire study (16 days).		Cost, nutrients, and fuel value of food per man per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Dols.*	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Fore quarter, 259 pounds, $18.13 (1); corned flank, 224.5 pounds, $15.72 (2)	33.85	6.9	61.4	102.3		1,156
Pork: Salt, 82.5 pounds, $8.25 (6)	8.25	1.7	5.4	50.8		473
Sausage: Bologna, 24 pounds, $2.16 (8); pork, 27.5 pounds, $2.48 (10)	4.64	.9	4.7	12.6	3.0	143
Fish: Cod, 35 pounds, $2.10 (11); mackerel, 44 pounds, $2.64 (12); salmon, 44 pounds, $2.64 (13)	7.38	1.5	18.3	9.8	.2	161
Dairy products: Butter, 46 pounds, $7.36 (15); condensed milk, 3 pounds, 23 cents (17)	7.59	1.5	.2	36.6	1.5	333
Lard compound, 142.5 pounds, $12.83 (18)	12.83	2.6		131.2		1,168
Total animal food	74.54	15.1	90.0	343.3	4.7	3,434
VEGETABLE FOOD.						
Cereals: Corn meal, 12.5 pounds, 31 cents (19); oatmeal, 2 pounds, 7 cents (20): rice, 8 pounds, 32 cents (21); wheat flour, 295 pounds, $5.90 (22); wheat flour, 87 pounds, $1.74 (23)	8.34	1.9	40.4	4.0	285.2	1,338
Sugars: Sugar, 138.5 pounds, $6.93 (25); molasses, 150 pounds, $3.12 (26)	10.05	2.0			239.2	957
Vegetables: Beans, 223.5 pounds, $9.39 (29); carrots, 12 pounds, 12 cents (32); peas, 10 pounds, 23 cents (34); potatoes, 171.5 pounds, $2.06 (35); onions, 0.5 pound, 2 cents (33); turnips, 63 pounds, 63 cents (36)	12.45	2.5	52.7	3.4	157.7	872
Fruits: Dried apples, 40.5 pounds, $3.65 (37); prunes, 61.5 pounds, $3.69 (39); raisins, 10 pounds, 75 cents (40); currant jelly, 16.5 pounds, 99 cents (41); strawberry jelly, 18.5 pounds, $1.11 (42)	10.19	2.1	1.8	1.1	90.8	380
Total vegetable food	41.03	8.5	94.9	8.5	772.9	3,547
Total food	115.57	23.6	184.9	351.8	777.6	6,981
WASTE.						
Beef, corned, 24 pounds (44)			2.5	13.8	.3	134
Beans, baked, 21 pounds (45)			3.1	2.1	8.3	64
Total waste			5.6	15.9	8.6	198
FOOD ACTUALLY EATEN.						
Animal food		15.1	87.5	329.5	4.4	3,300
Vegetable food		8.5	91.8	6.4	764.6	3,483
Total food eaten		23.6	179.3	335.9	769.0	6,783

DIETARY STUDY NO. 392.

The study began with supper April 27, 1902, and continued ten days. The crew were engaged in river driving. The list of men in the study, their occupation, the number of meals eaten, the daily menu.

and the weights and costs of foods and nutrients are given in the tables which follow:

TABLE 6.—*Data regarding subjects, dietary study No. 392.*

Name.	Subject of dietary study Nos.—	Place of birth.	Age.	Weight.	Occupation.
			Years.	*Pounds.*	
T. G	391, 392, 393	Maine	--------	--------	Lumberman.
C. J	390, 391, 392, 393	do	56	168	Overseer.
N. G	390, 391, 392	do	27	182	Clerk.
E. R. M	390, 391, 392, 393, 394	do	24	150	Chemist.
G. C	392	do	54	159	Cook.
W. R	390, 392, 394	Canada	29	177	Cookee.
J. T	392	do	23	153	Do.
A. F	392	do	24	161	Wagon man.
T. H	390, 391, 392	do	68	210	Blacksmith.
G. C	392	Maine	31	143	Teamster.
C. B	392	Canada	28	134	Driver.
L. B	392	do	28	153	Do.
M. B	390, 392	do	30	142	Do.
N. C	392	do	24	154	Do.
D. C	392	do	24	168	Do.
P. C	392	do	31	176	Do.
J. D	390, 391, 392	do	26	151	Do.
N. D	392	do	25	147	Do.
J. D	392	do	23	141	Do.
C. D	392	do	25	159	Do.
C. D	392	do	24	150	Do.
H. D	392	New Hampshire	47	171	Do.
E. F	390, 391, 392, 394	Canada	24	170	Do.
C. G	392	Maine	23	154	Do.
J. G	392	Canada	26	164	Do.
J. H	390, 391, 392	do	30	155	Do.
M. L	392	do	33	169	Do.
F. M	392	do	24	176	Do.
S. M	392	Vermont	30	147	Do.
S. M	392	Canada	29	171	Do.
S. P	392	do	24	155	Do.
J. P	390, 391, 392	do	26	169	Do.
A. P	390, 391, 392	do	24	150	Do.
A. R	390, 391, 392, 393	do	29	155	Do.
F. St. P	392	do	29	145	Do.
H. S	392	Maine	45	169	Do.
N. S	392	do	32	147	Do.
P. T	392	Canada	25	147	Do.
E. T	390, 392	do	24	155	Do.
F. W	392	do	31	162	Do.
G. W	392	do	27	176	Do.
W. W	392	do	27	161	Do

Daily menu.

SUNDAY, APRIL 27, 1902.

Supper.—Pea soup, biscuit, cookies, tea, molasses.

MONDAY, APRIL 28.

Breakfast.—Baked beans, biscuit, cookies, tea, molasses.
First lunch.—Baked beans, biscuit, cookies, tea, molasses.
Second lunch.—Baked beans, biscuit, cookies, tea, molasses.
Supper.—Baked beans, biscuit, soft gingerbread, tea, molasses.

TUESDAY, APRIL 29.

Breafast.—Baked beans, biscuit, cookies, tea, molasses.
First lunch.—Baked beans, biscuit, cookies, tea, molasses.
Second lunch.—Baked beans, biscuit, cookies, tea, molasses.
Supper.—Baked beans, biscuit, cookies, tea, molasses.

WEDNESDAY, APRIL 30.

Breakfast.—Baked beans, biscuit, butter, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, butter, soft gingerbread, tea, molasses.

Supper.—Codfish, potatoes, biscuit, butter, soft gingerbread, tea, molasses.

THURSDAY, MAY 1.

Breakfast.—Baked beans, biscuit, butter, soft gingerbread, tea, molasses.

First lunch.—Baked beans, biscuit, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, cookies, tea, molasses.

Supper.—Baked beans, codfish, biscuit, cookies, tea, molasses.

FRIDAY, MAY 2.

Breakfast.—Baked beans, biscuit, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, cookies, tea, molasses.

Supper.—Baked beans, biscuit, butter, cookies, soft gingerbread, tea, molasses.

SATURDAY, MAY 3.

Breakfast.—Baked beans, eggs, biscuit, butter, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Supper.—Boiled corned beef, boiled potatoes, biscuit, butter, cookies, tea, molasses.

Midnight supper.—Baked beans, boiled corned beef, boiled potatoes, biscuit, butter, cookies, tea, molasses.

SUNDAY, MAY 4.

Breakfast.—Baked beans, biscuit, butter, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Supper.—Boiled corned beef, boiled potatoes, biscuit, butter, cookies, tea, molasses.

MONDAY, MAY 5.

Breakfast.—Baked beans, biscuit, butter, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Supper.—Boiled codfish, boiled potatoes, biscuit, butter, cookies, tea, molasses.

Midnight supper.—Baked beans, boiled potatoes, biscuit, butter, cookies, tea, molasses.

TUESDAY, MAY 6.

Breakfast.—Baked beans, eggs, biscuit, butter, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Supper.—Boiled corned beef, boiled potatoes, biscuit, butter, cookies, tea, molasses.

WEDNESDAY, MAY 7.

Breakfast.—Baked beans, biscuit, butter, cookies, tea, molasses.

First lunch.—Baked beans, biscuit, butter, cookies, tea, molasses.

Second lunch.—Baked beans, biscuit, butter, soft gingerbread, cookies, tea, molasses.

The number of meals taken was as follows:

	Meals.
Camp crew:	
Breakfasts	350
First lunches	333
Second lunches	333
Suppers	350
Midnight suppers	46
Visitors:	
Breakfasts	3
First lunches	5
Second lunches	6
Suppers	5
Total meals	1,431

Equivalent to 4 meals per day for 1 man for 358 days.

TABLE 7.—*Weights and cost of food and nutrients in dietary study No. 392.*

Food consumed during the entire study (10 days).		Cost, nutrients, and fuel value of food per man per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Dols.*	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Corned flank, 135 pounds, $9.45 (2)	9.45	2.6	22.1	50.0		533
Pork: Salt, 127 pounds, $12.70 (6)	12.70	3.5	11.4	107.6		1,003
Fish: Cod, 55 pounds, $3.30 (11)	3.30	.9	13.2	.3		55
Eggs: Hens', 42 pounds, $5.13 (14)	5.13	1.4	6.3	5.0		70
Dairy products: Butter, 14 pounds, $2.24 (15)	2.24	.6		15.3		136
Lard compound, 65 pounds, $5.85 (18)	5.85	1.6		82.2		732
Total animal food	38.67	10.6	53.0	260.4		2,529
VEGETABLE FOOD.						
Cereals: Wheat flour, 329 pounds, $6.58 (23)	6.58	1.8	47.1	3.8	315.8	1,485
Sugars: Molasses, 50 pounds, $1.05 (26)	1.05	.3			51.0	204
Vegetables: Beans, 137 pounds, $5.75 (29); peas, 40 pounds, 92 cents (34); potatoes, 120 pounds, $1.44 (35)	8.11	2.3	54.8	3.3	158.8	884
Fruits: Raisins, 8 pounds, 60 cents (40)	.60	.1	.2	.3	6.9	31
Total vegetable food	16.34	4.5	102.1	7.4	532.5	2,604
Total food	55.01	15.1	155.1	267.8	532.5	5,133
WASTE.						
Beef, corned, 6 pounds			.8	4.7	.1	45
Beans, baked, 13 pounds			2.6	1.7	7.0	54
Total waste			3.4	6.4	7.1	99
FOOD ACTUALLY EATEN.						
Animal food		10.6	52.2	255.7		2,485
Vegetable food		4.5	99.5	5.7	525.5	2,550
Total food		15.1	151.7	261.4	525.5	5,035

DIETARY STUDY NO. 393.

The study began with supper November 17, 1902, and continued six days. The crew were engaged in chopping and yarding. The list of the men, their occupation, the number of meals eaten, the daily menu, and the weights and costs of foods and nutrients are given in the tables which follow:

TABLE 8.—*Data regarding subjects, dietary study No. 393.*

Name.	Subject of dietary study Nos.—	Place of birth.	Age.	Weight.	Occupation.
			Years.	*Pounds.*	
C. J	390, 391, 392, 393	Maine	57	169	Overseer.
E. C. G	393, 394	do	22	133	Chief clerk.
C. C	393	do	22	147	Clerk.
E. R. M	390, 391, 392, 393, 394	do	24	148	Chemist.
L. P	393	do	49	135	Cook.
J. B	393	Canada	18	138	Cookee.
F. D	393	do	23	156	Do.
D. T	393	Maine	16	129	Do.
J. R	393	Canada	32	172	Blacksmith.
W. C	390, 391, 393	Maine	49	174	Toter.
W. B	393	do	28	176	Chopper.
J. B	393	Canada	26	169	Do.
E. B	393	do	24	179	Do.
H. D	393	do	25	176	Do.
T. D	393	do	23	170	Do.
J. L	393	do	24	150	Do.
E. T	393	do	26	163	Do.
A. V	393	do	25	173	Swamper.
F. W	393	do	27	181	Do.
A. W	393	do	24	176	Do.
A. A	393	do	24	173	Do.
F. B	393	do	20	154	Do.
O. C	393	do	25	161	Do.
B. C	393	do	29	159	Do.
O. C	393	do	27	157	Do.
F. G	393	do	23	159	Do.
A. G	393	do	26	172	Do.
A. L	393	do	23	168	Do.
J. L	393	do	21	148	Do.
A. R	390, 391, 392, 393	do	30	157	Do.
G. R	393	do	24	167	Do.
P. R	393	do	25	159	Do.
D. T	393	do	59	185	Do.
M. V	393	do	29	131	Do.
J. W	393	do	29	129	Do.
J. B	393	do	25	139	Teamster.
F. B	393	do	28	142	Do.
C. B	393	Maine	37	162	Do.
G. C	393	do	29	147	Do.
I. G	393	do	21	154	Do.
H. H	393	Canada	28	179	Sled tender.
A. M	393	do	25	163	Do.
J. M	393	do	27	158	Do.
J. S	393	do	24	167	Do.
E. W	390, 391, 393	do	27	174	Do.
J. A	393	do	23	165	Yard roller.
S. B	393	do	26	154	Do.
P. C	393	do	22	148	Do.
A. C	393	do	23	156	Do.
A. L	393	do	28	167	Do.

Daily menu.

NOVEMBER 17, 1902.

Supper.—Vegetable soup, tripe, biscuit, sugar cookies, cake, butter, tea, sugar, molasses.

NOVEMBER 18.

Breakfast.—Baked beans, tripe, biscuit, beet pickles, sugar cookies, mince pie, tea, coffee, sugar, butter, molasses.

Dinner.—Baked beans, cold roast beef, biscuit, cookies, tea, molasses.

Supper.—Boiled potatoes, beef smother, mashed turnips, biscuit, sugar cake, butter, tea, sugar.

NOVEMBER 19.

Breakfast.—Baked beans, beet pickles, biscuit, butter, molasses cookies, sugar cake, apple sauce, tea, sugar, molasses.

Dinner.—Baked beans, cold corned beef, biscuit, cookies, sugar, tea, molasses.

Supper.—Codfish, boiled potatoes, biscuit, sugar cookies, tea, sugar, apple sauce, butter, molasses.

NOVEMBER 20.

Breakfast.—Baked beans, tripe, biscuit, sugar cookies, apple sauce, tea, coffee, sugar, molasses.

Dinner.—Baked beans, cold roast beef, biscuit, molasses, tea, sugar cookies.

Supper.—Fried steak, boiled potatoes, boiled onions, biscuit, molasses cookies, sugar cake, apple sauce, tea, sugar, molasses.

NOVEMBER 21.

Breakfast.—Baked beans, biscuit, butter, sugar cake, apple sauce, tea, coffee, sugar.

Dinner.—Baked beans, cold beef, biscuit, cookies, tea, molasses.

Supper.—Boiled potatoes, boiled mackerel, tripe, biscuit, butter, sugar cake, tea, sugar.

NOVEMBER 22.

Breakfast.—Baked beans, tripe, biscuit, butter, molasses cookies, sugar cookies, apple sauce, coffee, tea, sugar.

Dinner.—Baked beans, cold corned beef, biscuit, molasses cookies, sugar cookies, tea, molasses.

Supper.—Vegetable soup, biscuit, doughnuts, sugar cake, apple sauce, tea, sugar, butter.

NOVEMBER 23.

Breakfast.—Baked beans, boiled ham, tripe, biscuit, butter, sugar cookies, sugar cake, coffee, tea, condensed milk.

Dinner.—Baked beans, vegetable soup, pickled beets, biscuit, sugar cookies, doughnuts, tea, sugar, butter.

The number of meals taken was as follows:

Camp crew:	Meals.
Breakfasts	293
Dinners	293
Suppers	294
Total number of meals	880

Equivalent to 1 man for 293 days.

TABLE 9.—*Weights and cost of food and nutrients in dietary study No. 393.*

Food consumed during the entire study (6 days).		Cost, nutrients, and fuel value of food per man per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Dols.*	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Forequarter, 139 pounds, $9.73 (1); corned flank, 89.5 pounds, $6.26 (2); canned corned, 30 pounds, $3 (3); tripe, 8 pounds, 48 cents (4)	19.47	6.6	63.3	83.0	0.3	993
Pork: Chuck, salt, 38 pounds, $3.80 (5); smoked shoulder, 19 pounds, $1.81 (7)	5.61	1.9	6.0	51.5	.6	484
Fish: Cod, 30 pounds, $1.80 (11); mackerel, 27½ pounds, $1.64 (12)	3.44	1.2	14.7	9.1		139
Dairy products: Butter, 38 pounds, $6.08 (16); condensed milk, 6 pounds, 45 cents (17)	6.53	2.2	1.1	45.0	11.2	450
Lard compound, 127 pounds, $11.43 (18)	11.43	3.9		196.4		1,748
Total animal food	46.48	15.8	85.1	385.0	12.1	3,814

TABLE 9.—*Weights and cost of food and nutrients, etc.*—Continued.

Food consumed during the entire study (6 days).		Cost, nutrients, and fuel value of food per man per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
VEGETABLE FOOD.						
	Dols.	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Cereals: Wheat flour, 315 pounds, $6.46 (24); rice, 2 pounds, 12 cents (21)	6.58	2.2	44.1	3.5	383.2	1,741
Sugars: Sugar, 252 pounds, $12.60 (25); molasses, 20 pounds, 40 cents (27)	13.00	4.4	.7		411.2	1,648
Vegetables: Beans, 76.5 pounds, $3.21 (30); beets, 56 pounds, 56 cents, (30a); cabbage, 46 pounds, 69 cents (31); carrots, 61 pounds, 61 cents (32); onions, 20 pounds, 48 cents (33); peas, 9.5 pounds, 22 cents (34); potatoes, 195 pounds, $2.34 (35); turnips, 86 pounds, 60 cents (36)	8.71	3.0	37.8	2.5	154.1	837
Fruit: Evaporated apples, 33 pounds, $2.97 (37)	2.97	1.0	.8	1.1	33.8	148
Total vegetable food	31.26	10.6	83.4	7.1	982.3	4,374
Total food	77.74	26.4	168.5	392.1	994.4	8,188
WASTE.						
Baked beans, 37 pounds			4.4	4.3	12.4	105
FOOD ACTUALLY EATEN.						
Animal food		15.8	85.1	385.0	12.1	3,816
Vegetable food		10.6	79.0	2.8	969.9	4,267
Total food eaten		26.4	164.1	387.8	982.0	8,083

DIETARY STUDY NO. 394.

The study began with supper January 20, 1903, and continued 8 days. The crew were engaged in drawing logs from the yards to the landing. The list of the men, their occupation, the number of meals eaten, the daily menu, and the weights and costs of foods and nutrients are given in the tables which follow:

TABLE 10.—*Data regarding subjects, dietary study No. 394.*

Name.	Subject of dietary study Nos.—	Place of birth.	Age.	Weight.	Occupation.
			Years.	*Pounds.*	
G. M	394	Canada	53	147	Overseer.
E. G	393, 394	Maine	22	135	Clerk.
E. M	390, 391, 392, 393, 394	do	25	149	Chemist.
J. P	394	Canada	63	168	Cook.
H. McK	394	do	17	126	Cookee.
W. R	390, 392, 394	do	29	172	Do.
P. M	394	do	26	168	Blacksmith.
F. M	394	do	25	150	Do.
N. H	394	do	34	183	Toter.
A. C	394	do	25	150	Main road man
J. C	394	do	24	142	Do.
A. F	394	do	23	162	Do.
O. B	390, 391, 394	do	26	183	Do.
E. F	390, 391, 392, 394	do	25	175	Yard man.
M. G	394	do	27	155	Do.
F. M	394	do	23	155	Do.
F. P	394	do	28	125	Do.
A. R	394	do	26	159	Do.
F. St. P	394	do	24	173	Do.
J. C	390, 391, 394	do	56	140	Teamster.
J. C	394	do	33	143	Do.
P. C	394	do	25	148	Do.
J. G	394	do	31	168	Do.
R. M	394	do	34	142	Do.
D. V	394	do	26	148	Do.
P. C	394	do	23	148	Landing man.
C. M	394	do	24	135	Do.
W. M	394	do	25	125	Do.
F. N	394	do	27	151	Do.
N. L	394	do	26	134	Do.
E. G	394	do	57	210	Scaler.

Daily menu.

JANUARY 20, 1903.

Supper.—Vegetable stew, biscuit, sugar cake, molasses cookies, butter, sugar, sirup, tea.

JANUARY 21.

Breakfast.—Baked beans, cold corned beef, biscuit, sugar cookies, mince pie, butter, sugar, sirup, tea, coffee.

Dinner.—Baked beans, Bologna sausage, biscuit, butter, molasses cookies, tea.

Supper.—Boiled potatoes, boiled codfish, biscuit, butter, molasses cookies, bread pudding, sugar, sirup, tea.

JANUARY 22.

Breakfast.—Baked beans, cold pork, biscuit, butter, sugar cookies, mince pie, coffee, sugar, molasses.

Dinner.—Baked beans, Bologna sausage, cold pork, biscuit, butter, sugar cake, molasses, tea.

Supper.—Boiled potatoes, boiled cabbage, boiled corned beef, biscuit, butter, molasses doughnuts, tea, sugar, molasses.

JANUARY 23.

Breakfast.—Baked beans, biscuit, butter, molasses doughnuts, mince pie, molasses cookies, tea, coffee, sugar, molasses.

Dinner.—Baked beans, Bologna sausage, cold pork, biscuit, butter, sugar cookies, tea, molasses.

Supper.—Boiled potatoes, boiled codfish, biscuit, butter, molasses cookies, bread pudding, tea, sugar, molasses.

JANUARY 24.

Breakfast.—Baked beans, biscuit, butter, sugar cookies, sugar doughnuts, mince pie, tea, coffee, sugar, molasses.

Dinner.—Baked beans, Bologna sausage, cold pork, biscuit, butter, molasses doughnuts, tea, molasses.

Supper.—Roast beef, boiled potatoes, biscuit, butter, sugar cookies, tea, sugar, molasses.

JANUARY 25.

Breakfast.—Baked beans, roast beef, biscuit, butter, sugar cookies, sugar doughnuts, tea, coffee, sugar, molasses.

Dinner.—Baked beans, roast beef, biscuit, butter, sugar doughnuts, sugar cookies, mince pie, tea, sugar, molasses.

Supper.—Roast beef, boiled potatoes, biscuit, butter, molasses cookies, mince pie, tea, sugar, molasses.

JANUARY 26.

Breakfast.—Baked beans, biscuit, butter, sugar cookies, molasses doughnuts, mince pie, tea, coffee, sugar.

Dinner.—Baked beans, Bologna sausage, cold pork (boiled), biscuit, butter, molasses cookies, tea, molasses.

Supper.—Vegetable soup, biscuit, butter, sugar cookies, tea, sugar, molasses.

JANUARY 27.

Breakfast.—Baked beans, corned beef, biscuit, butter, sugar cookies, sugar doughnuts, mince pie, tea, coffee, sugar, molasses.

Dinner.—Baked beans, cold pork (boiled), biscuit, butter, gingerbread, tea, molasses.

Supper.—Boiled corned beef, boiled potatoes, boiled cabbage, biscuit, butter, molasses cookies, tea, sugar, molasses.

JANUARY 28.

Breakfast.—Baked beans, boiled corned beef, biscuit, butter, sugar cookies, mince pie, tea, sugar, molasses.

Dinner.—Baked beans, Bologna sausage, canned corned beef, biscuit, butter, gingerbread, tea, molasses.

The number of meals taken was as follows:

	Meals.
Camp crew:	
Breakfasts	241
Dinners	239
Suppers	241
Visitors:	
Breakfasts	8
Dinners	3
Suppers	6
Total number of meals	738

Equivalent to 1 man for 246 days.

TABLE 11.—*Weights and cost of food and nutrients in dietary study No. 394.*

Food consumed during the entire study (8 days).		Cost, nutrients, and fuel value of food per man per day.				
Kinds and amounts.	Cost.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
ANIMAL FOOD.	*Dols.*	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef: Forequarter, 167 pounds, $11.69 (1); flank, corned, 50 pounds, $3.50 (2); canned corned, 4 pounds, 40 cents (3)	15.59	6.3	58.5	81.6	--------	960
Pork: Salt chuck, 62 pounds, $6.20 (5)	6.20	2.5	4.8	75.7	1.2	698
Sausage: Bologna, 34 pounds, $3.06 (9)	3.06	1.2	8.7	6.9	2.5	106
Fish: Cod, 18 pounds, $1.08 (11)	1.08	.4	6.3	.1	.1	26
Dairy products: Butter, 21 pounds, $3.36 (16); condensed milk, 5 pounds, 42 cents (17)	3.78	1.5	.9	29.9	9.1	306
Lard compound, 64 pounds, $5.76 (18)	5.76	2.3	--------	117.8	--------	1,048
Total animal food	35.47	14.2	79.3	312.0	13.0	3,144
VEGETABLE FOOD.						
Cereals: Wheat flour, 311 pounds, $6.22 (24)	6.22	2.6	51.6	3.8	441.6	2,006
Sugars: Sugar, 60 pounds, $3 (25); sirup, 25 pounds, 50 cents (28); molasses, 18 pounds, 36 cents (27)	3.86	1.6	.8	--------	168.0	675
Vegetables: Beans, 68 pounds, $2.86 (30); cabbage, 89 pounds, $1.34 (31); onions, 11 pounds, 26 cents (33); potatoes, 217 pounds, $2.60 (35)	7.06	3.0	35.4	2.4	145.9	796
Fruit: Apples, dried, 12 pounds, $1.08 (37); raisins, 11 pounds, 80 cents (40); strawberry jelly, 12 pounds, 72 cents (42)	2.60	1.1	.9	1.1	46.8	201
Total vegetable food	19.74	8.3	88.7	7.3	802.3	3,678
MISCELLANEOUS FOOD.						
Mince-meat, 32 pounds, $3.20 (43)	3.20	1.3	3.9	.8	35.5	164
Total food	55.21	23.8	171.9	320.1	850.8	6,986
WASTE.						
Baked beans, 25 pounds	--------	--------	3.7	3.5	10.0	86
Cabbage, 6 pounds	--------	--------	.2	.5	.8	8
Pudding, 6 pounds	--------	--------	.4	.5	.8	9
Total waste	--------	--------	4.3	4.5	11.6	103
FOOD ACTUALLY EATEN.						
Animal food	--------	14.9	83.2	312.8	13.0	3,168
Vegetable food	--------	8.9	84.4	2.8	826.2	3,715
Total food eaten	--------	23.8	167.6	315.6	839.4	6,883

DISCUSSION OF THE DIETARIES.

The following table summarizes the results of dietary studies with Maine lumbermen. For purposes of comparison it also includes the results of a number of studies with German lumbermen, Russian and American workingmen engaged in severe labor, and athletes, as well as the commonly accepted American dietary standards.

TABLE 12.—*Summary of results of dietary studies of Maine lumbermen and others at severe work—Quantities per day.*

Persons or groups.	Cost.	Protein.	Fat.	Carbohydrates.	Fuel value.
Maine lumbermen:					
Chopping and yarding—	*Cents.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Dietary No. 390	28.6	247	386	944	8,199
Dietary No. 393	26.4	164	388	982	8,085
Average	27.5	206	387	963	8,140
Drawing logs to landing—					
Dietary No. 391	23.6	179	336	769	6,782
Dietary No. 394	23.8	168	316	839	6,836
Average	23.7	173	326	804	6,888
River driving, dietary No. 392	15.1	152	261	526	5,035
Average of above dietary studies with Maine lumbermen	23.5	182	337	812	6,995
Bavarian lumbermen at severe work:					
Jachenau, Tölz[a]	--------	144	358	606	6,186
Reichenhall Mountains[a]	--------	112	309	691	5,962
Oberandorfer Mountains[a]	--------	135	208	876	5,895
Average	--------	130	292	724	6,015
Bavarian farm laborers at severe work:					
Average of three dietaries	--------	137	202	546	4,330
Russians at severe work:[a]					
Sawyers, Astrakhan[b]	--------	211	93	868	5,283
Mowers, Astrakhan[b]	--------	216	153	537	4,651
Carpenters, Astrakhan[b]	--------	144	73	693	4,108
Workmen and laborers, Cronstadt Dock—					
Food costing $3.85 per month[c]	--------	123	43	563	3,207
Food costing $5.78 per month[c]	--------	122	52	419	2,704
Food costing $10.40 per month[c]	--------	146	140	460	3,785
Laborers, Cronstadt Dock—					
Ordinary diet[d]	--------	220	95	931	5,603
Diet during Lent or other church fasts[d]	--------	216	95	1,040	6,033
Miners, Tomsk—					
Minimum diet[e]	--------	248	55	965	5,482
Maximum diet[e]	--------	281	66	1,075	6,174
New England men at severe work:					
Teamsters and marble workers	--------	254	363	826	7,551
Brickmakers	--------	180	365	1,150	8,569
Athletes:					
Football teams	--------	226	354	634	6,590
Rowing clubs	--------	155	177	440	3,955
Bicyclists	--------	186	186	651	5,003
French Canadians:					
Brickmakers, Massachusetts	--------	109	185	603	4,495
Factory operatives, Massachusetts	--------	123	209	529	4,468
Laborers, Canada	--------	108	106	526	3,479
Dietary standards (Atwater):					
Man with very hard muscular work	--------	175	(*f*)	(*f*)	5,500
Man with hard muscular work	--------	150	(*f*)	(*f*)	4,150
Man with moderately active muscular work	--------	125	(*f*)	(*f*)	3,400
Man with light to moderate muscular work	--------	112	(*f*)	(*f*)	3,050
Man at "sedentary" or woman with moderately active work	--------	100	(*f*)	(*f*)	2,700

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 191. Quoted from Höfler (Jachenau), and Liebig.

[b] Soudakov, quoted by P. Smolensky, Traité Hygiène, Paris, 1904, p. 14.

[c] Tichkov, quoted by P. Smolensky, Traité Hygiène, Paris, 1904, p. 15.

[d] Ivanov, quoted by P. Smolensky, Traité Hygiène, Paris, 1904, p. 15.

[e] Réoutovsky, quoted by P. Smolensky, Traité Hygiène, Paris, 1904, p. 15.

[f] Fats and carbohydrates in sufficient amounts to furnish, together with the protein, the indicated amount of energy.

In each of the two years included in the investigation the largest amount of total food was eaten per man per day while the men were at the hard and continuous work of felling and trimming trees and swamping roads. In yarding logs the hauls were short and the men got no respite from work. In the first study (No. 390) the amount of protein eaten was very much larger than in any of the others and may have been excessive. There is nothing in the recorded data to explain this. The meats did not differ in kind, quality, or variety from those used in the similar dietary (No. 393) made the second year. The total protein in the food eaten in dietary No. 393 was very nearly the same as in the studies made when the men were at work drawing logs to the landing. Very likely the protein in dietary No. 390 may be above or that in dietary No. 393 may be below a normal amount for these men. Possibly the average more nearly represents the usual amount of protein contained in the food while the men are at work chopping and yarding than either of the studies alone. The needs of the body resulting from the severe character of this kind of labor are perhaps better indicated by the high fuel value (8,140 calories per man per day) of the food consumed, and this factor agrees quite closely in the two studies. The fat is practically the same in the two dietaries. Quite a little more of the total energy of the food came from the carbohydrates and less from the protein in dietary No. 393 than in dietary No. 390.

There is very close agreement, which is doubtless more or less accidental, in the quantities of nutrients and energy in studies Nos. 391 and 394, made in different years while the men were drawing logs to the landing. The food eaten in these two studies furnished on an average one-sixth less protein and one-sixth less energy than in the average of the two studies (Nos. 390. and 393) while chopping and yarding. The smaller quantity of food eaten in studies Nos. 391 and 394 was very likely due in part to differences in amount and character of work done. The work of loading and unloading logs is less continuous than that of felling and trimming trees and swamping roads, and the teamsters do not work nearly so hard on the comparatively long haul to the landing as on the short hauls when yarding. There would therefore be less bodily demand for food at such times. On the other hand, it may be that the food supplied in studies Nos. 390 and 393 was better than that to which the men had been accustomed before going into camp, and, as they had then been in the woods a comparatively short time, it would be natural that in such a case they would eat more than after having had this kind of diet for several weeks. In other words, even if the amount of work had been the same in studies Nos. 391 and 394 as in Nos. 390 and 393, the amount of food eaten might still have been less, because at the later period the diet would seem less appetizing to the men who had been eating it for a considerable length of time.

It is natural to suppose that the men who worked on the drives, wet with the icy water of early spring and eating four and sometimes five meals a day, would consume more food than any other class of lumber workers, but while making the preliminary arrangements for the experiments it was learned from the operators that in their opinion this was not the case. They stated that it took 25 per cent more food and cost nearly twice as much to feed the men while at work in the woods, particularly early in the season, as it did when upon the drives. In spite of this the comparatively small amounts of nutrients and energy supplied by the food eaten while the men were on the drive seem surprising, the protein and the energy of the diet in this case (dietary No. 392) being one-fourth less than when the crew was at work chopping. The articles included in the daily menus help to explain this. In dietaries Nos. 390, 391, 393, and 394 there was a considerable variety in the food, as great, in fact, as has been noted in studies with a considerable number of men in comparable circumstances who lived closer to markets; but when driving logs the men were compelled to eat alone, wherever the cookee chanced to find them, and their four or five meals per day were made up invariably of beans, biscuits, cookies, tea, and molasses. These conditions might naturally tend to lessen the appetite. This study (No. 392) was made when the lumber crew had just begun driving logs—that is, immediately after they had been living upon a more abundant diet. As may be seen by reference to the data in the tables regarding the weights of the men at the beginning of the several dietary studies (pp. 16, 18, 22, 25, and 27), this change was accompanied by a loss of weight in the case of the men in dietary No. 392, who were engaged in severe work (driving logs), as compared with their weights in earlier studies. There were nine such men (T. H., M. B., J. D., E. F., J. H., J. P., A. F., A. R., and E. T.), and in all cases except one loss of weight was observed, ranging from 1 to 9 pounds and being on an average 6 pounds. In the case of the ninth man (E. T.) there was a small gain, namely, 1 pound.

By reference to Table 12 it may be seen that the amount of protein in the dietary of the Maine lumbermen when chopping and yarding considerably exceeded the amount called for by the commonly accepted American dietary standard for men at very hard muscular work. In the case of men drawing logs to the landing it was practically equal to the amount called for by this standard, and in the case of the men engaged in river driving it was considerably less, being practically the amount called for by the standard for men with hard muscular work. Considering the average of all the studies, the amount of protein was only 12 grams in excess of the standard for men at very hard muscular work. As regards energy, the average amount furnished by the dietaries of men engaged in chopping and yarding and in drawing logs to the landing was far in excess of the amounts called for by the standard for very hard muscular work. When engaged in driving logs on the river the amount of energy observed (5,035 calories) was less than that demanded by this standard, namely, 5,500 calories. In the average of all five studies the amount of energy per man per day was almost 1,500 calories above the standard mentioned.

It seems fair to say, therefore, that judged by the best available data the diet of the Maine lumbermen appeared to be sufficient as regards both protein and energy. That it was not excessive, however, was indicated by the fact that the men did not gain markedly in weight, and certainly if it may be assumed that the appetite is a guide to the amount of food required the men did not eat more than they needed. The exposure to wet and cold may have been one of the causes for the consumption of large amounts of food. The idea is often advanced that men are more resistant to disease when they live at a high protein level. If this view is correct the large amount of protein observed was perhaps an advantage, and it is at least possible that the dietary which is typical of Maine lumber camps in general has been adopted because experience has shown that it is suited to the conditions under which the men live and work. The general health of the men in the studies recorded remained good, notwithstanding the severe work and exposure. Of course the vigorous out-of-door life in the pure air of the Maine woods was a factor favorable to health.

The only other studies of lumbermen's dietaries so far as the writers know are those made in the Bavarian Mountain regions by Liebig and by Hoefler. The dietary of the peasant in the region where these studies and dietaries, which are summarized in Table 12, were made is discussed by Ranke[a] in effect as follows:

In contrast to the conditions prevalent elsewhere in Germany, the food of the country people in the Bavarian highlands and mountains is very simple, and although potatoes have not become the principal food material there the food is chiefly vegetable. The famous peasant of the Bavarian Mountain region, the genuine "Haberfeldtreiber," as he proudly calls himself, eats meat, in accordance with the time-honored usage, only on the four great holidays of the year. He lives upon "Schmalzkost," that is to say, simple preparations of flour, with which large quantities of fat are incorporated. To these he adds such materials as sauerkraut and dried apples or peas. The food of these powerful peasants is so generous in amount as to explain their herculean development of muscle, their enviable vigor, and their consciousness of strength, which often leads to excess. It is likewise a current observation by people in the Tegernsee Mountains that the larger their appetites the more work the lumbermen can do.

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[a] Quoted in U. S. Dept. Agr., Office of Experiment Stations Bul. 21, p. 190.

By reference to Table 12 it will be seen that as regards both protein and energy the dietary of the Maine lumbermen on an average exceeded that of the Bavarians.

As regards the protein, the Maine lumbermen received in general somewhat smaller amounts than the Russian laborers at severe work, but the amounts of energy in their dietaries were larger. The amounts of fat in the Russian dietaries were notably small. The foods eaten by the Russian laborers differ much in character from those commonly used in America, and therefore a more detailed comparison would hardly be warranted, as the digestibility of the foods is a matter which should always be taken into account.

With the exception of one study with a football team the dietaries of the New England men at severe work quoted in Table 12 are the largest hitherto reported in connection with the series of nutrition investigations of which the present studies are a part, though it should be pointed out that these were compiled from statistics of food purchased as shown by the books of the boarding-house keepers, and are therefore only approximations, whereas the dietaries of the football teams, bicyclists, and rowing clubs were carefully made and, like those of the lumbermen here reported, show the nutrients and fuel value of the food actually eaten. The dietaries of the Maine lumbermen on an average exceeded the dietaries of athletes very considerably as regards energy. In the case of protein the average amount is smaller than was observed with the football teams, but greater than in the case of the rowing clubs.

As most of the men in the Maine lumbermen dietaries were French Canadians, the results of some other dietary studies of men of this nationality are given. The large size of these dietaries of men at work in the Maine woods as compared with the results of other studies of French Canadians is striking.

THE COST OF THE FOOD.

In the dietaries of the Maine lumbermen the cost of food ranged from 15.1 cents per person per day in the case of the men driving logs on the river to 28.6 cents in the case of one of the studies made with men who were chopping and yarding. On an average the total cost was 23.5 cents. The sum expended for animal food ranged from 10.6 cents in the case of dietary No. 392 (river driving) to 18.1 cents in the case of dietary No. 390 (chopping and yarding). The amount expended for vegetable food ranged from 4.5 cents with dietary No. 392 to 10.6 cents with dietary No. 393 (chopping and yarding). It will be seen that on an average about two-thirds of the total expenditure was for animal food and about one-third for vegetable food. The proportion of the total cost that was expended for different articles of diet in these studies is shown in the following table:

TABLE 13.—*The comparative cost of foods per man per day in dietary studies in Maine lumber camps.*

Kind of food.	Dietary No. 390.	Dietary No. 393.	Average Nos. 390 and 393.	Dietary No. 391.	Dietary No. 394.	Average Nos. 391 and 394.	Dietary No. 392.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Beef	14.3	25.0	19.7	29.2	28.0	28.6	17.2
Pork	20.6	7.2	13.9	7.2	11.1	9.2	23.2
Sausage	3.4	----------	1.7	3.8	5.3	4.5	6.0
Fish	12.9	4.5	8.7	6.4	1.8	4.1	9.3
Dairy products	4.9	8.3	6.6	16.4	6.7	6.6	4.0
Lard	7.2	14.8	11.0	11.0	10.2	10.6	10.5
Total animal food	63.3	59.8	61.6	64.0	63.1	63.6	70.2
Cereals	8.7	8.3	8.5	8.1	11.6	9.8	11.9
Sugars	4.2	16.7	10.4	8.5	7.1	7.8	2.0
Vegetables	16.1	11.4	13.8	10.5	12.3	11.9	15.3
Fruits	7.7	3.8	5.7	8.9	4.9	6.9	.6
Total vegetable food	36.7	40.2	38.4	36.0	36.9	36.4	29.8
Total food	100.0	100.0	100.0	100.0	100.0	100.0	100.0

AMOUNT OF FOOD WASTED.

The food wasted in these dietary studies was very small in amount, being limited to the portions left uneaten on the plates. The total waste equaled only about 3 per cent of the protein and 2 per cent of the energy of the total food supplied.

SOURCES OF PROTEIN AND ENERGY.

The tables which follow show the percentages of the total protein and energy supplied by the more important foods and by the total animal and total vegetable foods:

TABLE 14.—*Sources of protein in dietary studies in Maine lumber camps.*

Kind of food.	Dietary No. 390.	Dietary No. 393.	Average Nos. 390 and 393.	Dietary No. 391.	Dietary No. 394.	Average Nos. 391 and 394.	Dietary No. 392.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Beef	13.6	37.7	25.7	33.2	34.9	34.1	14.2
Pork	10.5	3.6	7.0	2.9	2.9	2.9	7.4
Sausage	2.4	----------	1.2	2.6	5.2	3.9	----------
Fish	17.3	7.9	12.6	9.9	3.2	6.5	8.5
Dairy products	.1	.6	.4	----------	.5	.3	[a] 4.1
Lard	----------	----------	----------	----------	----------	----------	----------
Total animal food	43.9	49.8	46.9	48.6	46.7	47.7	34.2
Cereals	23.3	26.9	25.0	21.9	31.1	26.5	30.4
Sugars	----------	.4	.2	----------	.5	.2	----------
Vegetables	32.2	22.4	27.3	28.5	21.2	24.9	35.4
Fruits	.7	.5	.6	1.0	.5	.7	----------
Total vegetable food	56.1	50.2	53.1	51.4	53.3	52.3	65.8
Total food	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] From eggs.

Table 15.—*Sources of energy in dietary studies in Maine lumber camps.*

Kind of food.	Dietary No. 390.	Dietary No. 393.	Average Nos. 390 and 393.	Dietary No. 391.	Dietary No. 394.	Average Nos. 391 and 394.	Dietary No. 392.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Beef	8.2	12.3	10.3	16.6	14.3	15.4	10.5
Pork	16.6	6.0	11.3	6.9	10.4	8.6	19.7
Sausage	1.0	----------	.5	2.1	1.6	1.9	1.0
Fish	5.9	1.7	3.8	2.3	.3	1.3	1.3
Dairy products	3.5	5.6	4.5	4.8	4.6	4.7	[a]2.7
Lard	11.4	21.6	16.5	16.9	15.6	16.3	14.5
Total animal food	46.6	47.2	46.9	49.6	46.8	48.2	49.7
Cereals	23.5	21.3	22.4	19.0	29.4	24.4	28.7
Sugars	7.6	20.1	13.9	13.6	9.9	11.8	3.9
Vegetables	17.4	9.6	13.5	12.4	10.9	11.6	17.1
Fruits	4.9	1.8	3.3	5.4	3.0	4.2	.6
Total vegetable food	53.4	52.8	53.1	50.4	53.2	51.8	50.3
Total food	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] From eggs.

While the men were at the camp chopping, yarding, and drawing the logs to the landing, the protein was obtained about equally from the animal and vegetable foods. When driving logs their diet was made up quite largely of beans, and only one-third of the protein was supplied by animal food. As regards energy, about half the total amount was supplied by animal foods and half by vegetable foods in all the studies, beef, pork, and lard being the most important animal foods in this respect and cereals and vegetables the most important vegetable foods.

DIGESTION EXPERIMENTS WITH MAINE LUMBERMEN ON A MIXED DIET.

In order to learn how completely the very large amount of food eaten by the lumbermen was assimilated, two series of digestion experiments were planned and carried out in the winter of 1902–3. In these studies the men had the same food as their companions who were in dietary studies Nos. 393 and 394, reported on pages 24 to 30 of this bulletin. They were not restricted in their food, and ate from the same mixed diet, in the same room, and at the same time as the rest of the crew. Three of the six experiments reported were made while the crew was engaged in the hard work of cutting and yarding the logs, and the remaining three while they were drawing the logs from the yards to the landing. The subjects were selected as being typical of the camp in vigor, in the amount of food they ate, and in their capacity for work. Each experiment began at noon and lasted six days. With the camp conveniences it was impracticable to use a marker and make a separation of the feces in the usual manner, but as the food eaten during the experiments was of the same character as that the subjects were eating before and after the experimental period, the feces for the six days following the one on which the experiment began were collected and were assumed to represent the undigested residues from the food eaten. Because of the uniformity of the diet, the regularity of the men in stooling, and the long duration of the experiment, it is believed that no serious error was thus introduced. The close agreement of the experiments also confirms the belief.

It was impracticable to collect the urine voided in these experiments, and therefore the balance of income and outgo of nitrogen was not ascertained.

COMPOSITION OF FOOD MATERIALS AND FECES.

All of the food materials were sampled at the time of use. Usually the same kind of food was used at several meals, and in such cases a composite sample was made for analysis. The samples were kept frozen in suitable jars and brought to the laboratory of the Maine Experiment Station, where they were dried, subsampled, and analyzed by the usual methods. The feces were deposited in large museum jars, and kept frozen until brought to the station for analysis. The heats of combustion of all of the foods and of the feces were determined by the usual method with the bomb calorimeter. The results of the analyses of the foods are included in Table 16 and of the feces in Table 17. In the case of the feces the analyses are reported on a water-free basis, as the amount of water in feces is not important in computing the results of digestion experiments.

TABLE 16.—*Composition of food materials in digestion experiments with Maine lumbermen.*

Laboratory No.	Kind of food.	Water.	Nitrogen.	Protein.	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
6743	Beef smother	65.08	2.22	13.89	14.74	3.82	3.47	2.284
6744	Corned beef, boiled	43.06	4.33	27.08	22.55	1.06	6.15	3.784
6745	Corned beef, canned	56.75	4.39	27.41	10.38	.74	4.72	2.509
6783	Corned beef, boiled	37.96	1.61	10.05	38.57	9.84	3.59	4.452
6784	Roast beef	58.03	5.19	32.45	8.07	......	1.83	2.089
6746	Pork chuck, salt	22.44	.67	4.16	66.26	1.02	6.12	6.124
6747	Bologna sausage	68.30	2.73	17.05	7.47	3.99	3.19	1.835
6786	do	66.16	2.30	14.40	11.31	4.04	4.09	2.039
6750	Codfish	54.05	4.90	30.59	6.67	.30	8.39	2.338
6751	Codfish hash	75.30	.74	4.63	3.21	15.19	1.67	1.172
6752	Butter	8.75	.06	.38	75.23	10.24	5.40	7.233
6754	Biscuit, sour dough	37.74	.98	6.12	8.06	47.71	.37	3.088
6791	do	34.50	1.06	6.62	6.83	51.53	.52	3.196
6755	Sugar cake	26.13	.54	3.37	5.76	63.60	1.14	3.328
6756	Gingerbread	22.37	.94	5.86	6.47	63.60	1.70	3.525
6795	do	21.14	.95	5.91	8.46	62.60	1.89	3.720
6757	Molasses cookies	18.08	.95	5.93	9.69	64.66	1.64	3.790
6794	do	19.30	.87	5.43	10.14	62.82	2.31	3.864
6758	Sugar cookies	21.85	.91	5.69	7.78	64.38	.30	3.710
6792	do	16.03	.91	5.68	11.65	65.94	.70	3.716
6759	Sugar doughnuts	14.98	.97	6.04	19.96	58.12	.90	4.533
6793	do	14.70	.74	4.61	27.04	53.21	.44	4.846
6796	Molasses doughnuts	18.49	.76	4.73	19.77	55.96	1.05	4.478
6761	Baked beans	61.37	1.26	7.88	5.74	22.35	2.66	1.887
6787	do	59.63	1.29	8.09	7.52	21.64	3.12	2.055
6762	Cabbage, boiled	87.96	.22	1.35	.88	7.72	2.09	.480
6788	do	84.68	.25	1.54	4.13	6.98	2.67	.733
6763	Potatoes, boiled	73.85	......	1.66	.03	23.69	.77	1.060
6789	do	76.07	.30	1.90	.03	21.22	.78	.978
6764	Potato soup	76.92	......	5.01	4.48	11.60	1.99	1.174
6790	Vegetable soup	84.62	.57	3.59	2.35	8.06	1.38	.756
6799	Mince pie	42.72	......	4.17	8.14	44.02	.95	2.791
6798	do	36.57	.76	4.74	11.34	46.68	.67	3.189
6797	Bread pudding	36.32	.51	3.21	4.36	54.33	1.78	2.853
6724	Strawberry jelly	17.00	......	......	......	83.00	......	3.403
6803	Molasses	26.49	......	2.33	......	68.00	3.16	2.759
......	Sugar	......	......	......	......	100.00	......	3.959

TABLE 17.—*Composition of water-free feces in digestion experiments with Maine lumbermen.*

Laboratory No.	Feces.	Protein.	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
6765	Experiment No. 463	48.33	12.04	28.05	11.58	5.257
6766	Experiment No. 464	48.59	11.17	30.54	9.70	5.351
6767	Experiment No. 465	45.98	7.56	38.02	8.44	5.267
6800	Experiment No. 466	52.77	9.52	28.39	9.32	5.502
6801	Experiment No. 467	49.18	10.47	29.64	10.71	5.284
6802	Experiment No. 468	51.16	10.10	29.07	9.67	5.382

DETAILS OF DIGESTION EXPERIMENTS.

The details of the digestion experiments are included in Tables 18–23. These show the kinds and amounts of food eaten by the subject. The quantities in the column "total organic matter" are the sums of the quantities in the three following columns, "protein," "fat," and "carbohydrates." The amounts of protein, fat, and carbohydrates in each food material and in the feces were computed from the weight of each material multiplied by its percentage composition and heat of combustion, as shown in Table 16. For convenience the same reference numbers for the food materials and feces are used in the tables of composition and in the tables giving the weights of nutrients in the foods. The differences between the total nitrogen of the food eaten and that rejected in the feces are taken as a measure of the total amount digested. The feces, however, do not consist solely of undigested residue, but contain a large amount of metabolic products. The amount of metabolic nitrogen in the feces, as found by two different methods, is given in Table 24 and discussed on page 55. The amounts of nutrients rejected in the feces, while not strictly representing the undigested parts of the food, do represent approximately the amounts which were not available to the body. The point has been discussed at length by Atwater.[a] The total amount of any particular kind of nutrient digested divided by the total amount of this nutrient in the food gives the percentage which is digestible or actually available to the body. These percentage values are called coefficients of digestibility. These coefficients are given in the last line of each of the tables showing the details of the digestion experiments and are summarized in the table on page 52.

While the coefficients of digestibility of the different nutrients represent the proportion which the body actually utilizes, the corresponding value for the heat of combustion of the food does not represent the actual amount of energy which the body obtains from the food absorbed from the alimentary canal. When protein is burned in the bomb calorimeter the carbon is oxidized to carbon dioxid and the hydrogen to water. The nitrogen is left in the free state. When protein is burned in the body, however, the oxidation is not so complete. The nitrogen is excreted in the urine largely in the form of urea, but with some uric acid and other allied compounds which also contain small amounts of carbon and hydrogen together with some oxygen. In estimating the actual fuel values of the digestible nutrients, allowance must be made for these incompletely oxidized residual products which are excreted by the kidneys. Urea is the most abundant of these products, and in lack of determinations of the actual heats of combustion of these incompletely oxidized products, estimates have sometimes been made on the assumption that all of the nitrogen excreted in the urine is thus combined, and allowance has been made for the heat of combustion of the amount of urea corresponding to the amount of nitrogen found in the urine or in the digestible protein in the food consumed. On this supposition 0.87 calorie of the energy latent in each gram of digestible protein would be lost to the body in the urea corresponding to the nitrogen of such protein. In a considerable number of actual determinations of the ratio of the nitrogen to heat of combustion in urine of healthy men, the average heat of combustion of the organic matter in the urine corresponding to 1 gram of digestible protein was found to be considerably greater than 0.87 calorie, and in the digestion work of the nutrition investigations of this Office it has been decided to use for the present, and until a more accurate factor has been ascertained, the factor 1.25 calories as more nearly corresponding to the energy of the urine for a gram of digestible protein. The figures given in the tables for the proportion of energy actually available to the body in the food eaten were obtained, therefore, by deducting from the total energy of the digested food the energy lost to the body in organic matter of the urine as determined by multiplying the total amount of digestible protein by 1.25.

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[a] Connecticut Storrs Station Rpts. 1896 and 1897.

DIGESTION EXPERIMENT NO. 463.

Kind and amounts of food.—A mixed diet with large amounts of baked beans, corned beef, biscuits, etc.

Subject.—A. F.

Age.—Twenty-three years.

Weight (with clothing).—At the beginning of the experiment, 162 pounds.

Duration.—Six days, with 18 meals, beginning with dinner December 3, 1902.

The daily menu, as well as the amounts of the individual foods eaten at each meal, was as follows:

Daily menu and amounts eaten at each meal.

DECEMBER 3.

Dinner.—Baked beans, 400 grams; canned corned beef, 76 grams; biscuit, 300 grams; sugar, 13.4 grams; butter, 27.2 grams.

Supper.—Vegetable soup, 720 grams; biscuit, 150 grams; butter, 27.2 grams; sugar, 13.4 grams.

DECEMBER 4.

Breakfast.—Baked beans, 150 grams; biscuit, 225 grams; sugar cookies, 38 grams; butter, 20.4 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 268 grams; canned corned beef, 70 grams; biscuit, 375 grams; sugar cookies, 47 grams; butter, 34 grams; sugar, 13.4 grams.

Supper.—Boiled corned beef, 148 grams; boiled cabbage, 541 grams; boiled potatoes, 160 grams; biscuit, 300 grams; butter, 13.6 grams; sugar, 13.4 grams.

DECEMBER 5.

Breakfast.—Baked beans, 215 grams; biscuit, 220 grams; sugar cake, 35 grams; butter, 20.4 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 370 grams; canned corned beef, 20 grams; biscuit, 300 grams; sugar cake, 53 grams; butter, 27.2 grams; sugar, 13.4 grams.

Supper.—Boiled codfish, 244 grams; boiled potatoes, 262 grams; pork chuck, 81 grams; biscuit, 240 grams; butter, 20.4 grams; sugar, 13.4 grams.

DECEMBER 6.

Breakfast.—Baked beans, 175 grams; biscuit, 225 grams; molasses cookies, 55 grams; butter, 20.4 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 385 grams; biscuit, 240 grams; butter, 20.4 grams; sugar, 13.4 grams.

Supper.—Codfish hash, 503 grams; pork chuck, 11 grams; biscuit, 400 grams; butter, 34 grams; sugar, 13.4 grams.

DECEMBER 7.

Breakfast.—Baked beans, 194 grams; biscuit, 225 grams; butter, 20.4 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 224 grams; canned corned beef, 121 grams; biscuit, 225 grams; sugar cookies, 150 grams; mince pie, 405 grams; butter, 20.4 grams; sugar, 13.4 grams.

Supper.—Vegetable soup, 570 grams; biscuit, 400 grams; butter, 34 grams; sugar, 13.4 grams.

DECEMBER 8.

Breakfast.—Baked beans, 154 grams; biscuit, 75 grams; mince pie, 278 grams; butter, 6.8 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 276 grams; Bologna sausage, 147 grams; biscuit, 300 grams; gingerbread, 94 grams; butter, 25.2 grams; sugar, 13.4 grams.

Supper.—Beef smother, 735 grams; boiled potatoes, 82 grams; biscuit, 375 grams; butter, 31.5 grams; sugar, 13.4 grams.

DECEMBER 9.

Breakfast.—Baked beans, 172 grams; biscuit, 225 grams; mince pie, 155 grams; butter, 18.9 grams; sugar, 13.4 grams.

TABLE 18.—*Results of digestion experiment No. 463.*

Laboratory No.	Kind of food.	Weight of materials.	Total organic matter.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
6743	Beef smother	735.0	238.50	102.10	108.30	28.1	18.20	1,679.00
6744	Corned beef, boiled	224.0	113.80	60.70	50.70	2.4	13.80	847.60
6745	Corned beef, canned	287.0	110.60	78.70	29.80	2.1	13.50	720.00
6746	Pork chuck, salt	92.0	65.80	3.80	61.00	1.0	5.60	563.40
6747	Bologna sausage	147.0	42.00	25.10	11.00	5.9	4.60	269.70
6750	Codfish	244.0	91.70	74.70	16.30	.7	20.40	570.50
6751	Codfish hash	503.0	115.80	23.30	16.10	76.4	8.40	550.30
6752	Butter	422.0	363.70	1.60	317.60	44.5	22.70	3,052.00
6754	Biscuit	4,802.0	2,971.90	293.90	387.00	2,291.0	17.80	14,824.60
6755	Sugar cake	403.0	293.10	13.60	23.20	256.3	4.00	1,341.10
6756	Gingerbread	94.0	71.40	5.50	6.10	59.8	1.60	331.30
6757	Molasses cookies	55.0	44.20	3.30	5.30	35.6	.90	208.40
6758	Sugar cookies	235.0	183.00	13.40	18.30	151.3	.70	872.00
6761	Baked beans	2,983.0	1,072.80	235.00	171.20	666.6	79.20	5,629.00
6762	Cabbage, boiled	541.0	53.90	7.30	4.80	41.8	11.30	259.70
6763	Potatoes, boiled	508.0	129.00	8.40	.20	120.4	3.90	538.50
6764	Potato soup	1,290.0	272.10	64.70	57.80	149.6	26.00	1,514.50
6799	Mince pie	838.0	472.00	34.90	68.20	368.9	8.00	2,339.50
	Sugar	241.0	241.00			241.0		954.10
	Total	13,483.0	6,946.30	1,050.00	1.352.90	4,543.4	261.20	37,069.20
6765	Feces (water-free)	324.0	286.50	156.60	39.00	90.9	37.50	1,703.30
	Amount digested		6,659.80	893.40	1.313.90	4,452.5	223.70	35,365.90
	Per cent digested		95.88	85.09	97.12	98.0	85.64	95.45
	Energy of urine							1,116.80
	Energy of food oxidized in the body							34,249.10
	Per cent of energy utilized							92.39

DIGESTION EXPERIMENT NO. 464.

Kind and amounts of food.—A mixed diet with large amounts of baked beans, corned beef, biscuits, vegetables, etc.

Subject.—E. F.

Age.—Twenty-five years.

Weight (with clothing).—At the beginning of the experiment, 175 pounds.

Duration.—Six days, with 18 meals, beginning with dinner, December 3, 1902.

The daily menu, as well as the amounts of the individual foods eaten at each meal, was as follows:

Daily menu and amounts eaten at each meal.

DECEMBER 3.

Dinner.—Baked beans, 350 grams; canned corned beef, 76 grams; biscuit, 380 grams; sugar cookies, 55 grams; butter, 34 grams; sugar, 13.4 grams.

Supper.—Vegetable soup, 840 grams; biscuit, 375 grams; sugar cake, 140 grams; butter, 34 grams; sugar, 13.4 grams.

DECEMBER 4.

Breakfast.—Baked beans, 178 grams; canned corned beef, 150 grams; biscuit, 150 grams; mince pie, 150 grams; butter, 13.6 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 400 grams; canned corned beef, 118 grams; biscuit, 300 grams; butter, 27.2 grams; sugar, 13.4 grams.

Supper.—Corned beef, 276 grams; boiled cabbage, 890 grams; boiled potatoes, 212 grams; biscuit, 75 grams; butter, 6.8 grams; sugar, 13.4 grams.

DECEMBER 5.

Breakfast.—Baked beans, 260 grams; corned beef, 88 grams; biscuit, 150 grams; mince pie, 150 grams; butter, 13.6 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 450 grams; canned corned beef, 50 grams; biscuit, 225 grams; sugar cake, 53 grams; butter, 20.4 grams; sugar, 13.4 grams.

Supper.—Boiled potatoes, 382 grams; boiled codfish, 307 grams; pork chuck, 102 grams; biscuit, 240 grams; molasses cookies, 50 grams; butter, 20.4 grams; sugar, 13.4 grams.

DECEMBER 6.

Breakfast.—Baked beans, 318 grams; biscuit, 225 grams; mince pie, 133 grams; butter, 20.4 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 263 grams; biscuit, 160 grams; sugar cookies, 100 grams; butter, 13.6 grams; sugar, 13.4 grams.

Supper.—Fish hash, 589 grams; pork chuck, 81 grams; biscuit, 200 grams; sugar cookies, 55 grams; butter, 20.4 grams; sugar, 13.4 grams.

DECEMBER 7.

Breakfast.—Baked beans, 200 grams; biscuit, 150 grams; doughnuts, 94 grams; butter, 13.6 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 285 grams; canned corned beef, 103 grams; biscuit, 300 grams; mince pie, 140 grams; butter, 27.2 grams; sugar, 13.4 grams.

Supper.—Vegetable soup, 911 grams; biscuit, 300 grams; molasses cookies, 63 grams; butter, 25.2 grams; sugar, 13.4 grams.

DECEMBER 8.

Breakfast.—Baked beans, 126 grams; Bologna sausage, 45 grams; biscuit, 150 grams; mince pie, 150 grams; butter, 12.6 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 327 grams; Bologna sausage, 98 grams; biscuit, 225 grams; butter, 18.9 grams; sugar, 13.4 grams.

Supper.—Beef smother, 1,227 grams; boiled potatoes, 165 grams; biscuit, 75 grams; butter, 6.3 grams; sugar, 13.4 grams.

DECEMBER 9.

Breakfast.—Baked beans, 115 grams; biscuit, 225 grams; mince pie, 155 grams; butter, 18.9 grams; sugar, 13.4 grams.

TABLE 19.—*Results of digestion experiment No. 464.*

Laboratory No.	Kind of food.	Weight of material.	Total organic matter.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
6743	Beef smother	1,227.0	398.20	170.50	180.80	46.90	30.30	2,802.50
6744	Corned beef, boiled	364.0	185.00	98.60	82.40	4.00	22.40	1,377.40
6745	Corned beef, canned	497.0	191.60	136.30	51.60	3.70	23.40	1,247.00
6746	Pork chuck, salt	183.0	130.80	7.60	121.30	1.90	11.20	1,120.70
6747	Bologna sausage	143.0	40.80	24.40	10.70	5.70	4.60	262.40
6750	Codfish	307.0	115.30	93.90	20.50	.90	25.80	7,177.70
6751	Codfish hash	589.0	135.70	27.30	18.90	89.50	9.80	690.20
6752	Butter	347.0	297.90	1.30	261.10	35.50	18.70	2,509.90
6754	Biscuit	3,905.0	2,416.70	239.00	314.70	1,863.00	14.40	12,058.60
6755	Sugar cake	193.0	140.40	6.50	11.10	122.80	2.20	642.30
6757	Molasses cookies	113.0	90.80	6.70	11.00	73.10	1.80	428.30
6758	Sugar cookies	213.0	165.70	12.10	16.60	137.00	.70	790.20
6759	Doughnuts	94.0	79.10	5.70	18.80	54.60	.80	426.10
6761	Baked beans	3,275.0	1,178.00	258.00	188.00	732.00	87.10	6,180.00
6762	Cabbage, boiled	890.0	88.50	12.00	7.80	68.70	18.60	427.20
6763	Potatoes, boiled	759.0	192.60	12.60	.20	179.80	5.80	804.50
6764	Potato soup	1.751.0	369.20	87.70	78.40	203.10	34.80	2,055.70
6799	Mince pie	878.0	494.60	36.60	71.50	386.50	8.30	2,450.50
	Sugar	241.0	241.00			241.00		954.10
	Total	15,969.0	6,951.90	1,236.80	1,465.40	4,249.70	320.70	44,405.30
6766	Feces (water-free)	436.0	393.70	211.80	48.70	133.20	42.30	2,333.00
	Amount digested		6,558.20	1,025.00	1,416.70	4,116.50	278.40	42,072.30
	Per cent digested		94.34	82.87	96.68	96.68	86.81	94.73
	Energy of urine							1,281.30
	Energy of food oxidized in body							40,791.00
	Per cent of energy utilized							91.86

DIGESTION EXPERIMENT NO. 465.

Kind and amounts of food.—A mixed diet with large amounts of baked beans, corned beef, biscuits, pastry, etc.

Subject.—E. T.

Age.—Twenty-five years.

Weight (*with clothing*).—At the beginning of the experiment, 155 pounds.

Duration.—Six days, with 18 meals, beginning with dinner, December 3, 1902.

The daily menu, as well as the amounts of the individual foods eaten at each meal, was as follows:

Daily menu and amounts eaten at each meal.

DECEMBER 3.

Dinner.—Baked beans, 420 grams; canned corned beef, 76 grams; biscuit, 300 grams; sugar cookies, 58 grams; butter, 27.2 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Supper.—Vegetable soup, 690 grams; biscuit, 225 grams; sugar cake, 140 grams; sugar cookies, 100 grams; butter, 30.4 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

DECEMBER 4.

Breakfast.—Baked beans, 214 grams; canned corned beef, 49 grams; biscuit, 225 grams; sugar cookies, 38 grams; mince pie, 150 grams; butter, 20.4 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Dinner.—Baked beans, 419 grams; canned corned beef, 103.5 grams; biscuit, 300 grams; sugar cookies, 94 grams; butter, 27.2 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Supper.—Boiled corned beef, 160 grams; boiled cabbage, 704 grams; boiled potatoes, 242 grams; biscuit, 225 grams; sugar cookies, 35 grams; butter, 20.4 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

DECEMBER 5.

Breakfast.—Baked beans, 311 grams; boiled corned beef, 35 grams; biscuit, 225 grams; mince pie, 150 grams; butter, 20.4 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Dinner.—Baked beans, 413 grams; canned corned beef, 118 grams; biscuit, 300 grams; sugar cookies, 65 grams; molasses cookies, 65 grams; butter, 27.2 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Supper.—Boiled potatoes, 372 grams; boiled codfish, 387 grams; pork chuck, 111 grams; biscuit, 80 grams; molasses cookies, 100 grams; butter, 6.8 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

DECEMBER 6.

Breakfast.—Baked beans, 346 grams; biscuit, 225 grams; mince pie, 133 grams; butter, 20.4 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Dinner.—Baked beans, 425 grams; canned corned beef, 30 grams; biscuit, 400 grams; sugar cookies, 130 grams; butter, 34 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Supper.—Codfish hash, 518 grams; biscuit, 320 grams; molasses cookies, 55 grams; sugar cookies, 55 grams; butter, 27.2 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

DECEMBER 7.

Breakfast.—Baked beans, 201 grams; biscuit, 225 grams; doughnuts, 94 grams; sugar cookies, 26 grams; butter, 21.4 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Dinner.—Baked beans, 295 grams; canned corned beef, 90 grams; biscuit, 300 grams; mince pie, 140 grams; butter, 25.2 grams; sugar, 13.4 grams; strawberry jelly, 50 grams.

Supper.—Vegetable soup, 596 grams; biscuit, 225 grams; sugar cookies, 63 grams; molasses cookies, 63 grams; butter, 18.9 grams; sugar, 13.4 grams.

DECEMBER 8.

Breakfast.—Baked beans, 285 grams; biscuit, 225 grams; mince pie, 140 grams; butter, 18.9 grams; sugar, 13.4 grams.

Dinner.—Baked beans, 205 grams; canned corned beef, 125 grams; biscuit, 300 grams; molasses gingerbread, 90 grams; butter, 25.2 grams; sugar, 13.4 grams.

Supper.—Beef smother, 980 grams; boiled potatoes, 270 grams; biscuit, 150 grams; molasses cookies, 140 grams; butter, 12.6 grams; sugar, 13.4 grams.

DECEMBER 9.

Breakfast.—Baked beans, 290 grams; biscuit, 225 grams; butter, 18.9 grams; sugar, 13.4 grams.

TABLE 20.—*Results of digestion experiment No. 465.*

Laboratory No.	Kind of food.	Weight of materials.	Total organic matter.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
6743	Beef smother	980.0	318.00	136.20	144.40	37.40	24.20	2,238.30
6744	Corned beef, boiled	195.0	99.10	52.80	44.20	2.10	12.00	737.90
6745	Corned beef, canned	591.0	227.70	162.00	61.30	4.40	27.90	1,482.80
6746	Pork chuck, salt	111.0	79.30	4.60	73.60	1.10	6.80	679.80
6750	Codfish	387.0	145.40	118.40	25.80	1.20	32.50	904.80
6751	Codfish hash	518.0	119.30	24.00	16.60	78.70	8.70	607.10
6752	Butter	393.0	337.40	1.50	295.70	40.20	21.20	2,842.60
6754	Biscuit	4,475.0	2,769.60	273.90	360.70	2,135.00	16.50	13,818.80
6755	Sugar cake	166.0	120.80	5.60	9.60	105.60	1.90	552.40
6756	Gingerbread	90.0	68.30	5.30	5.80	57.20	1.50	317.20
6757	Molasses cookies	423.0	339.50	25.10	41.00	273.40	6.90	1,603.20
6758	Sugar cookies	638.0	496.60	36.30	49.60	410.70	1.90	2,367.00
6759	Doughnuts	94.0	79.10	5.70	18.80	54.60	.80	426.10
6761	Baked beans	3,824.0	1,375.50	301.30	219.50	854.70	101.70	7,215.90
6762	Cabbage, boiled	704.0	70.10	9.50	6.20	54.40	14.70	337.90
6763	Potatoes, boiled	884.0	224.40	14.70	.30	209.40	6.80	937.20
6764	Potato soup	1,286.0	271.20	64.40	57.60	149.20	25.50	1,510.00
6799	Mince pie	713.0	401.60	29.70	58.00	313.90	6.80	1,990.00
6724	Strawberry jelly	650.0	539.50			539.50		2,211.40
	Sugar	241.0	241.00			241.00		954.10
	Total	17,363.0	8,323.40	1,271.40	1,488.70	5,563.70	318.30	43,735.00
6767	Feces (water-free)	339.9	311.20	156.30	25.70	129.20	28.70	1,790.30
	Amount digested		8,012.20	1,115.10	1,463.00	5,434.50	289.60	41,944.70
	Per cent digested		96.26	87.70	98.27	97.68	90.98	95.96
	Energy of urine							1,393.40
	Energy of food oxidized in the body							40,551.30
	Per cent of energy utilized							92.72

DIGESTION EXPERIMENT NO. 466.

Kind and amounts of food.—A mixed diet, with large amounts of baked beans, meat, and salt fish, potatoes, biscuits, pastry, etc.

Subject.—O. B.

Age.—Twenty-six years.

Weight (with clothing).—At the beginning of the experiment, 183 pounds.

Duration.—Six days, with 18 meals, beginning with supper January 21, 1903.

The daily menu, as well as the amounts of the individual foods eaten at each meal, was as follows:

Daily menu and amounts eaten at each meal.

JANUARY 21.

Supper.—Boiled potatoes, 380 grams; boiled codfish, 140 grams; biscuit, 140 grams; bread pudding, 570 grams; molasses cookies, 35 grams; sugar, 26 grams; sirup, 5.5 grams.

JANUARY 22.

Breakfast.—Baked beans, 217 grams; biscuit, 240 grams; sugar cookies, 51 grams; mince pie, 137 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 359 grams; Bologna sausage, 145 grams; biscuit, 306 grams; sugar cookies, 54 grams; sugar, 26 grams; sirup, 5.5 grams.

Supper.—Boiled potatoes, 714 grams; boiled corned beef, 232 grams; biscuit, 70 grams; molasses doughnuts, 95 grams; sugar, 26 grams; sirup, 5.5 grams.

JANUARY 23.

Breakfast.—Baked beans, 285 grams; biscuit, 210 grams; molasses doughnuts, 60 grams; mince pie, 86 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 415 grams; biscuit, 275 grams; sugar cookies, 160 grams; sugar, 26 grams; sirup, 5.5 grams.

Supper.—Boiled potatoes, 503 grams; boiled codfish, 188 grams; biscuit, 70 grams; bread pudding, 441 grams; sugar, 26 grams; sirup, 5.5 grams.

JANUARY 24.

Breakfast.—Baked beans, 335 grams; biscuit, 216 grams; sugar cookies, 50 grams; sugar doughnuts, 50 grams; mince pie, 140 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 260 grams; biscuit, 246 grams; molasses doughnuts, 57 grams; sugar, 26 grams; sirup, 5.5 grams.

Supper.—Boiled potatoes, 700 grams; roast beef, 240 grams; biscuit, 140 grams; sugar cookies, 100 grams; sugar, 26 grams; sirup, 5.5 grams.

JANUARY 25.

Breakfast.—Baked beans, 113 grams; biscuit, 140 grams; sugar doughnuts, 92 grams; roast beef, 26 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 264 grams; roast beef, 40 grams; biscuit, 270 grams; mince pie, 262 grams; sugar, 26 grams; sirup, 5.5 grams.

Supper.—Boiled potatoes, 545 grams; roast beef, 125 grams; biscuit, 70 grams; molasses cookies, 50 grams; mince pie, 260 grams; sugar, 26 grams; sirup, 5.5 grams.

JANUARY 26.

Breakfast.—Baked beans, 210 grams; biscuit, 140 grams; sugar doughnuts, 100 grams; mince pie, 125 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 380 grams; biscuit, 320 grams; molasses cookies, 135 grams; sugar, 26 grams; sirup, 5.5 grams.

Supper.—Vegetable soup, 618 grams; biscuit, 280 grams; sugar cookies, 50 grams; sugar, 26 grams; sirup, 5.5 grams.

JANUARY 27.

Breakfast.—Baked beans, 250 grams; corned beef, 76 grams; biscuit, 280 grams; mince pie, 120 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 315 grams; biscuit, 320 grams; gingerbread, 145 grams; sugar, 26 grams; sirup, 5.5 grams.

TABLE 21.—*Results of digestion experiment No. 466.*

Laboratory No.	Kind of food.	Weight of materials.	Total organic matter.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
6783	Corned beef, boiled	308.0	180.00	30.90	118.80	30.30	11.10	1,371.00
6784	Roast beef	431.0	174.70	139.90	34.80	----------	7.90	900.60
6786	Bologna sausage	145.0	43.10	20.90	16.40	5.80	5.90	295.70
6750	Codfish	328.0	123.20	100.30	21.90	1.00	27.50	767.00
6787	Baked beans	3,403.0	1,267.80	275.30	255.90	736.60	106.20	6,994.00
6789	Potatoes, boiled	2,842.0	651.80	54.00	.80	603.00	22.20	2,779.50
6790	Vegetable soup	618.0	86.50	22.20	14.50	49.80	8.50	467.20
6791	Biscuit	3,733.0	2,425.60	247.10	255.00	1,923.50	19.40	11,930.00
6792	Sugar cookies	465.0	387.20	26.40	54.20	306.60	3.30	1,728.00
6793	Sugar doughnuts	242.0	205.40	11.20	65.40	128.80	1.10	1,172.80
6794	Molasses cookies	220.0	172.40	11.90	22.30	138.20	5.10	850.10
6795	Gingerbread	145.0	111.70	8.60	12.30	90.80	2.70	539.50
6796	Molasses doughnuts	212.0	170.50	10.00	41.90	118.60	2.20	949.50
6797	Bread pudding	1,011.0	625.80	32.50	44.10	549.20	18.00	2,884.20
6798	Mince pie	1.130.0	709.20	53.50	128.10	527.60	7.50	3,604.20
	Sugar	468.0	468.00	----------	----------	468.00	----------	1,852.70
	Molasses	99.0	69.60	2.30	----------	67.30	----------	276.70
	Total	15,800.0	7,878.50	1,047.00	1,086.40	5,745.10	251.70	39,362.70
6800	Feces (water-free)	328.0	297.40	173.10	31.20	92.10	30.60	1,804.70
	Amount digested	----------	7,581.10	873.90	1,055.20	5,652.00	221.10	37,558.00
	Per cent digested	----------	96.23	83.47	97.13	98.38	87.84	95.42
	Energy of urine	----------	----------	----------	----------	----------	----------	1,092.40
	Energy of food oxidized in the body	----------	----------	----------	----------	----------	----------	36,465.60
	Per cent of energy utilized	----------	----------	----------	----------	----------	----------	92.64

DIGESTION EXPERIMENT NO. 467.

Kind and amounts of food.—A mixed diet with large amounts of baked beans, codfish, vegetables, biscuit, pastry, etc.

Subject.—A. C.

Age.—Twenty-five years.

Weight (with clothing).—At the beginning of the experiment, 150 pounds.

Duration.—Six days, with 18 meals, beginning with supper, January 21, 1903.

The daily menu, as well as the amounts of the individual foods eaten at each meal, was as follows:

Daily menu and amounts eaten at each meal.

JANUARY 21.

Supper.—Boiled potatoes, 220 grams: boiled codfish, 130 grams; biscuit, 140 grams: bread pudding, 260 grams: molasses cookies, 135 grams: sugar, 26 grams: sirup, 5.5 grams: butter, 5.3 grams.

JANUARY 22.

Breakfast.—Baked beans, 241 grams; pork chuck, 30 grams; biscuit, 240 grams: mince pie, 137 grams; butter, 5.3 grams; sugar, 26 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 350 grams: pork chuck, 35 grams; biscuit, 166 grams: sugar cookies, 54 grams; butter, 5.3 grams; sugar, 26 grams; sirup, 5.5 grams.

Supper.—Boiled potatoes, 773 grams; boiled cabbage, 439 grams; boiled corned beef, 126 grams; biscuit, 140 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

January 23.

Breakfast.—Baked beans, 345 grams; biscuit, 210 grams; mince pie, 86 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 340 grams; biscuit, 208 grams; pork chuck, 48 grams; sugar cookies, 42 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 231 grams; boiled codfish, 188 grams; biscuit, 140 grams; bread pudding, 302 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

January 24.

Breakfast.—Baked beans, 334 grams; biscuit, 216 grams; mince pie, 140 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 320 grams; biscuit, 128 grams; molasses doughnuts, 151 grams; pork chuck, 40 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 240 grams; roast beef, 195 grams; biscuit, 140 grams; sugar cookies, 50 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

January 25.

Breakfast.—Baked beans, 319 grams; roast beef, 39 grams; biscuit, 140 grams; sugar cookies, 56 grams; sugar doughnuts, 46 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 325 grams; roast beef, 35 grams; biscuit, 106 grams; sugar doughnuts, 46 grams; mince pie, 131 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 255 grams; roast beef, 150 grams; biscuit, 140 grams; sugar, 26 grams; butter, 5.5 grams; sirup, 5.3 grams.

January 26.

Breakfast.—Baked beans, 195 grams; biscuit, 210 grams; sugar doughnuts, 45 grams; mince pie, 125 grams; sugar, 26 grams; butter, 5.3 grams; sirup, 5.5 grams.

Dinner.—Baked beans, 310 grams; pork chuck, 75 grams; biscuit, 180 grams; molasses cookies, 100 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Vegetable soup, 784 grams; biscuit, 140 grams; sugar cookies, 50 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

January 27.

Breakfast.—Baked beans, 350 grams; biscuit, 140 grams; corned beef, 37 grams; mince pie, 120 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 345 grams; biscuit, 235 grams; molasses gingerbread, 145 grams; pork chuck, 37 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

TABLE 22.—*Results of digestion experiment No. 467.*

Laboratory No.	Kind of food.	Weight of material.	Total organic matter.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
6783	Corned beef, boiled	163.0	95.30	16.40	62.90	16.00	5.80	725.80
6784	Roast beef	419.0	169.70	135.90	33.80	----------	7.70	875.40
6746	Pork chuck, salt	265.0	189.30	11.00	175.50	2.70	16.20	1,623.00
6750	Codfish, boiled	318.0	119.50	97.30	21.30	.90	26.70	743.60
6752	Butter	95.4	82.00	.30	71.70	10.00	5.10	690.00
6786	Baked Beans	3,774.0	1,405.90	305.30	283.80	816.80	117.70	7,757.00
6788	Cabbage, boiled	439.0	55.60	6.80	18.10	30.70	11.70	321.80
6789	Potatoes, boiled	1,719.0	398.00	32.70	.50	364.80	11.40	1,681.30
6790	Vegetable soup	784.0	109.80	28.20	18.40	63.20	101.80	592.70
6791	Biscuit	3,021.0	1,963.30	200.00	206.30	1,557.00	15.70	9,656.00
6792	Sugar cookies	252.0	209.80	14.30	29.30	166.20	1.80	936.50
6793	Sugar doughnuts	137.0	116.20	6.30	37.00	72.90	.60	664.00
6794	Molasses cookies	235.0	184.20	12.80	23.80	147.60	5.40	998.20
6795	Gingerbread	145.0	111.70	8.60	12.30	90.80	2.70	539.50
6796	Molasses doughnuts	151.0	121.50	7.10	29.90	84.50	1.60	676.30
6797	Bread pudding	562.0	347.90	18.00	24.60	305.30	10.00	1,603.20
6798	Mince pie	739.0	463.80	35.00	83.80	345.00	4.90	2,356.50
	Sugar	468.0	468.00	----------	----------	468.00	----------	1,842.80
	Molasses	99.0	69.60	2.30	----------	67.30	----------	276.70
	Total	13,785.4	6,681.10	938.30	1.133.10	4,609.70	258.90	34,470.30
6801	Feces	284.3	253.90	139.80	29.80	84.30	30.40	1,502.20
	Amount digested	----------	6,427.20	798.50	1,103.30	4,525.40	227.50	32,968.10
	Per cent digested	----------	96.19	85.10	97.37	98.17	87.87	95.64
	Energy of urine	----------	----------	----------	----------	----------	----------	998.10
	Energy of food oxidized in the body	----------	----------	----------	----------	----------	----------	31,970.00
	Per cent of energy utilized	----------	----------	----------	----------	----------	----------	92.75

DIGESTION EXPERIMENT NO. 468.

Kind and amounts of food.—A mixed diet, with large amounts of baked beans, corned beef, codfish, potatoes, biscuit, etc.

Subject.—F. St. P.

Age.—Twenty-four years.

Weight (with clothing).—At the beginning of the experiment, 173 pounds.

Duration.—Six days, with 18 meals, beginning with supper, January 21, 1903.

The daily menu, as well as the amounts of the individual foods eaten at each meal, was as follows:

Daily menu and amounts eaten at each meal.

JANUARY 21.

Supper.—Boiled potatoes, 735 grams; boiled codfish, 208 grams; biscuit, 140 grams; molasses cookies, 35 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

JANUARY 22.

Breakfast.—Baked beans, 226 grams; pork chuck, 38 grams; biscuit, 160 grams; sugar cookies, 51 grams; sugar, 26 grams; sirup 5.5 grams; butter, 5.3 grams.

Dinner.—Boiled potatoes, 175 grams; baked beans, 119 grams; pork chuck, 50 grams; biscuit, 113 grams; sugar cookies, 53 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 445 grams; boiled corned beef, 130 grams; boiled cabbage, 500 grams; biscuit, 70 grams; molasses doughnuts, 77 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

JANUARY 23.

Breakfast.—Baked beans, 313 grams; biscuit, 140 grams; molasses doughnuts, 55 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Boiled cabbage, 210 grams; boiled corned beef, 120 grams; biscuit, 274 grams; sugar cookies, 100 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 243 grams; boiled codfish, 177 grams; biscuit, 140 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

JANUARY 24.

Breakfast.—Baked beans, 194 grams; biscuit, 174 grams; sugar cookies, 50 grams; sugar doughnuts, 56 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 155 grams; biscuit, 267 grams; sugar doughnuts, 112 grams; sugar cookies, 50 grams; pork chuck, 26 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 407 grams; roast beef, 195 grams; biscuit, 140 grams; sugar cookies, 50 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

JANUARY 25.

Breakfast.—Baked beans, 106 grams; biscuit, 140 grams; sugar cookies, 56 grams; sugar doughnuts, 92 grams; roast beef, 60 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 190 grams; roast beef, 40 grams; biscuit, 108 grams; sugar doughnuts, 138 grams; mince pie, 131 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Boiled potatoes, 400 grams; roast beef, 160 grams; biscuit, 140 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

JANUARY 26.

Breakfast.—Baked beans, 205 grams; biscuit, 140 grams; sugar doughnuts, 45 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 180 grams; roast beef, 89 grams; biscuit, 187 grams; sugar cookies, 120 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Supper.—Vegetable soup, 1,408 grams; biscuit, 140 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

JANUARY 27.

Breakfast.—Baked beans, 320 grams; biscuit, 140 grams; sugar cookies, 50 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

Dinner.—Baked beans, 142 grams; vegetable soup, 420 grams; biscuit, 208 grams; gingerbread, 121 grams; sugar, 26 grams; sirup, 5.5 grams; butter, 5.3 grams.

TABLE 23.—*Results of digestion experiment No. 468.*

Laboratory No.	Kind of food.	Weight of materials.	Total organic matter.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
6783	Corned beef, boiled	250.0	146.10	25.10	95.40	24.60	9.00	1,113.00
6784	Roast beef	544.0	220.40	176.50	43.90		9.90	1,136.00
6746	Pork chuck, salt	114.0	81.50	4.70	75.60	1.20	7.00	698.20
6750	Codfish	385.0	144.60	117.80	25.70	1.10	32.30	900.30
6752	Butter	95.4	82.00	.30	71.70	10.00	5.10	690.00
6787	Baked beans	2,150.0	800.90	173.90	161.70	465.30	67.10	4,419.00
6788	Cabbage, boiled	710.0	89.80	10.90	29.30	49.60	18.90	520.40
6789	Potatoes, boiled	2.405.0	556.80	45.70	.70	510.40	18.70	2,352.00
6790	Vegetable soup	1,828.0	255.80	65.60	42.90	147.30	25.20	1,382.00
6791	Biscuit	2,821.0	1,833.00	186.80	192.70	1,453.50	14.70	9,017.00
6792	Sugar cookies	560.0	466.40	31.80	65.30	369.30	3.90	2,081.00
6793	Sugar doughnuts	443.0	375.90	20.40	119.80	235.70	2.00	2,147.00
6794	Molasses cookies	35.0	27.40	1.90	3.50	22.00	.80	135.30
6795	Gingerbread	121.0	93.10	7.10	10.20	75.80	2.30	450.20
6796	Molasses doughnuts	132.0	106.20	6.20	26.10	73.90	1.40	591.20
6798	Mince pie	131.0	82.30	6.20	14.90	61.20	.70	307.80
	Sugar	468.0	468.00			468.00		1,842.80
	Sirup	99.0	69.60	2.30		67.30	3.10	276.70
	Total	13,291.4	5,899.80	883.20	980.40	4,036.20	222.10	30,069.90
6802	Feces	208.6	188.40	106.70	21.10	60.60	20.20	1,122.70
	Amount digested		5,711.40	776.50	959.30	3,975.60	201.90	28,947.20
	Per cent digested		96.81	87.92	97.84	98.59	90.90	96.37
	Energy of urine							970.60
	Energy of food oxidized in the body							27,976.60
	Per cent of energy utilized							93.00

METABOLIC PRODUCTS IN THE FECES.

The feces are not made up entirely of undigested food residues, but contain quite a large amount of other waste materials, usually termed metabolic products. As ordinarily used, however, this term not only includes the metabolic products, strictly speaking, such as the residues from the bile, mucus, saliva, gastric, pancreatic, and other digestive secretions, but also includes worn-out particles from the mucous membrane, lining of the intestines, other débris from the walls of the stomach, and, perhaps, larger or smaller quantities of specifically excretory matters. The results of other investigations indicate that the digestion of food materials is more complete and the proportion of metabolic products in the feces larger than was formerly supposed. It is not at all improbable that during the processes of natural digestion, aided by careful preparation of the food and proper mastication, practically all of the nutrients of most foods are rendered absorbable in the alimentary canal, and that undigested residues are rather accidental than incidental. In view of the importance of this subject the metabolic nitrogen of the feces in these digestion experiments has been studied by the same method as in the past. The metabolic nitrogen was determined by two methods described in detail in a previous bulletin of this Office.[a] In the first, the metabolic products are removed by digestion with pepsin solution, and in the second, by treatment with ether, alcohol, hot water, and cold limewater. The results obtained by these methods, and the coefficients of digestibility of nitrogen (protein) in the different experiments when corrections are applied according to the data thus obtained, are given in the table which follows:

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 85.

TABLE 24.—*Coefficients of digestibility of nitrogen (protein) of food when allowance is made for nitrogen of metabolic products in feces.*

[Mixed diet.]

Experiment.	Nitrogen in food.	Weight of water-free feces.	Total nitrogen in feces.		Feces treated with pepsin.				Feces treated with ether, alcohol, hot water, and limewater.			
					Nitrogen in feces not dissolved.		Corrected digestibility of nitrogen of food.		Nitrogen in feces not dissolved.		Corrected digestibility of nitrogen of food.	
	Grams.	*Grams.*	*P. ct.*	*Grams.*	*P. ct.*	*Grams.*	*Grams.*	*Per ct.*	*P. ct.*	*Grams.*	*Grams.*	*P. ct.*
No. 463	168.0	351.0	7.13	25.02	2.04	7.16	160.84	95.73	2.97	10.42	157.58	93.79
No. 464	197.9	473.0	7.17	33.91	2.12	10.03	187.87	94.93	3.11	14.71	183.19	92.56
No. 465	203.4	371.6	6.73	25.01	2.22	8.25	195.15	95.94	3.62	13.45	189.95	93.38
No. 466	167.5	363.0	7.63	27.70	2.52	9.15	158.35	94.54	4.16	15.10	152.40	90.98
No. 467	150.1	309.4	7.23	22.37	2.46	7.61	142.49	94.93	4.04	12.49	137.61	91.67
No. 468	141.3	230.4	7.41	17.07	2.16	4.98	136.30	96.46	3.61	8.32	132.98	94.11

SUMMARY OF RESULTS OF DIGESTION EXPERIMENTS.

In the following table are summarized the coefficients of digestibility of the nutrients and availability of the energy in the food eaten in the digestion experiments with lumbermen who were on a mixed diet. In the case of protein the values are given as determined and as corrected for metabolic products in the feces.

TABLE 25.—*Summary of results, including corrected values for protein, of digestion experiments with Maine lumbermen.*

[Mixed diet.]

Experiment.	Total organic matter.	Protein.			Fat.	Carbohydrates.	Ash.	Fuel value.
		Not corrected.	Corrected by pepsin method.	Corrected by ether, alcohol, etc., method.				
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per ct.*	*Per cent.*	*Per ct.*	*Per ct.*
No. 463	95.9	85.1	95.7	93.8	97.1	98.0	85.6	92.4
No. 464	94.3	82.9	94.9	92.6	96.7	96.7	86.8	91.8
No. 465	96.3	87.7	95.9	93.4	98.3	97.7	91.0	92.7
Average	95.5	85.2	95.5	93.3	97.3	97.5	87.8	92.3
No. 466	96.2	83.5	94.5	91.0	97.1	98.4	87.8	92.6
No. 467	96.2	85.1	94.9	91.7	97.4	98.2	87.9	92.8
No. 468	96.8	87.9	96.5	94.1	97.8	98.5	90.9	93.0
Average	96.4	85.3	95.3	92.3	97.4	98.4	88.9	92.8
Average of all	96.0	85.3	95.4	92.8	97.4	98.0	88.4	92.6

The digestion experiments with Maine lumbermen were undertaken principally to secure data for estimating the proportions of the nutrients of a mixed diet actually utilized by the body under the experimental conditions previously noted. As may be seen from the figures summarized above, the results for the different subjects were for the most part quite uniform, the range in percentages of digestibility of the different nutrients being from 82.9 to 87.9 for protein, 96.7 to 98.3 for fat, and 96.7 to 98.5 for carbohydrates, while the availability of energy ranged from 91.8 to 93 per cent. The average of the results for all six subjects, i. e., protein 85.3 per cent, fat 97.4 per cent, carbohydrates 98 per cent, and energy 92.6 per cent, therefore, gives a fair indication of the digestibility of the nutrients and availability of the energy of the diet under the conditions of these experiments.

On the basis of a large amount of data obtained in upward of 400 digestion experiments made in connection with the nutrition investigations of this Office, of which those here reported form a part, it has been estimated that on the average about 92 per cent of the protein, 95 per cent of the fat, 97 per cent of the carbohydrates, and 91 per cent of the energy of ordinary mixed diet is digested and made available to the body. It will be noticed that except in the case of the protein there is a fairly close agreement between these factors and the average of the results of the digestion experiments summarized above. The discrepancy in the case of the protein may doubtless be accounted for by differences in the proportion of animal and vegetable protein in the diet. That is, in the diet of the present experiments, as shown by the figures in Table 28 beyond, about 60 per cent of the total protein on the average was derived from vegetable food and only 40 per cent from animal food, whereas in the experiments upon which the above-mentioned factors were based the average proportion of protein from animal foods was more nearly 60 per cent and that from vegetable foods 40 per cent. Since the digestibility of vegetable protein is lower than that of animal food, obviously the digestibility of total protein would be lower in the diet in which vegetable protein predominates, as in the present case.

If these facts be taken into consideration it would appear that the men in these experiments digested the protein of their diet, as well as the other nutrients, in very nearly the proportions that have been found for the average individual on ordinary mixed diet. This may be illustrated by a comparison between the results actually determined in the experiments and those calculated from the data of food eaten by use of factors representing the average digestibility of the nutrients in different classes of food materials. Such factors, deduced mainly from the results of the large number of digestion experiments referred to above, are here given.[a]

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[a] Connecticut Storrs Station Rpt. 1899, p. 86.

TABLE 26.—*Coefficients of digestibility of nutrients of different groups of food materials and of total nutrients of mixed diet.*

	Protein.	Fat.	Carbohydrates.
	Per cent.	*Per cent.*	*Per cent.*
Animal foods	97	95	98
Cereals	85	90	98
Legumes, dried (beans and peas)	78	90	97
Sugars and starches	----------	----------	98
Vegetables	83	90	95
Fruits	85	90	90
Vegetable foods	85	90	97
Total food	92	95	97

On the assumption that the nutrients of the different classes of food materials in the diet eaten during the experiment would be digested in the proportions given in the above table, the digestibility of each nutrient in the total diet would be for each experiment as given in the columns headed "Calculated" in the following table, while the results actually found are given in the columns headed "Determined."

TABLE 27.—*Comparison of coefficients of digestibility as found by actual experiment and as calculated by factors in experiments Nos. 463–468.*

Experiment.	Protein.		Fat.		Carbohydrates.	
	Determined.	Calculated.	Determined.	Calculated.	Determined.	Calculated.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
No. 463	85.09	87.90	97.12	94.78	98.00	97.28
No. 464	82.87	89.14	96.68	94.94	96.68	97.08
No. 465	87.70	88.16	98.27	94.94	97.68	96.58
No. 466	83.47	86.96	97.13	94.95	98.38	97.16
No. 467	85.10	86.37	97.37	94.86	98.17	97.23
No. 468	87.92	87.84	97.84	94.83	98.49	97.30
Average of six studies	85.35	87.73	97.40	94.88	97.90	97.11

In every case but one the agreement between the calculated coefficients and those actually found is reasonably close, and would indicate, as expressed above, that these men, under the experimental conditions already described, digested the nutrients of their diet in about the same proportions as have been found for the average individual on an ordinary mixed diet. The exception noted is that of the digestion of protein by the subject in experiment No. 464, with whom the result actually found was noticeably lower than that calculated by average coefficients. This discrepancy between the results as calculated and as actually found in the case of this man would suggest that he digested either animal protein, or perhaps both animal and vegetable protein, less thoroughly than has been found in the average with other individuals. The reason why the deficiency would seem rather to be with the animal protein is found in the fact that the proportion of protein from animal food in the diet of this subject was larger than in that of either of the others, as shown by the data in Table 28.

The coefficients of digestibility of protein, when corrections are made for metabolic products in the feces, are of course larger than those found by deducting the total feces from the total food consumed, as shown by the data in Table 25 (page 52). It should be observed that the corrections for metabolic products obtained by the two methods followed differ somewhat, the digestibility being higher when corrections are introduced in accordance with results obtained by the pepsin method. This is perhaps accounted for by the fact that treating the feces with pepsin would undoubtedly remove protein of undigested food material as well as metabolic products, while treatment with solvents (ether, alcohol, and limewater) would not affect the protein of undigested residue. However, too little information is available at present for a satisfactory discussion of this point.

SOURCES OF THE NUTRIENTS.

Since numerous investigations have shown that animal foods are more completely digested than those of vegetable origin, it was thought interesting in these experiments with a man on a mixed diet to determine as nearly as possible the sources of the different nutrients—that is, the proportion derived from animal and vegetable foods. Several of the food materials were of a mixed character, so a somewhat arbitrary classification was necessary; thus, in the case of codfish hash and vegetable soup it was assumed that all the carbohydrates and a part of the protein and fat were furnished by the potatoes used in making them, the amount of protein and fat being calculated from the average values for these nutrients in boiled potatoes. The rest of the protein and fat was assumed to be of animal origin. Similarly, in the case of mince pie, two-thirds of the protein and fat were considered as of animal origin, and the remaining protein and fat and all the carbohydrates were assumed to be of vegetable origin. The larger part of the fat of baked beans was not derived from the beans themselves, but from the pork added. This amounted on an average to nearly 16 per cent of the total fat of the food, and in the accompanying table is classed with the animal fats. While this apportionment is only a rough approximation it seemed to be the best that could be devised and is sufficiently accurate for the purpose. The data regarding the source of the different nutrients are summarized in the following table:

TABLE 28.—*Relative amounts of nutrients and energy supplied by different food materials.*

Kind of food.	Protein.	Fat.	Carbohydrates.	Ash.	Energy.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Digestion experiment No. 463:					
Baked beans	22.37	[a]1.39	14.67	15.16	11.56
Other vegetable food	37.07	34.56	84.44	24.57	52.67
Total vegetable food	59.44	35.95	99.11	39.73	71.23
Total animal food	40.56	64.05	.89	60.27	28.77
Digestion experiment No. 464:					
Baked beans	20.85	[a]1.41	17.22	13.56	10.59
Other vegetable food	28.16	[b]27.57	80.46	13.81	46.02
Total vegetable food	49.01	28.98	97.68	27.37	56.61
Total animal food	50.99	71.02	2.32	72.63	43.39
Digestion experiment No. 465:					
Baked beans	23.70	[a]1.62	15.36	15.99	12.52
Other vegetable food	32.93	[b]34.34	83.08	18.16	59.42
Total vegetable food	56.63	35.96	98.44	34.15	71.98
Total animal food	43.37	[b]64.04	1.56	65.86	28.06
Digestion experiment No. 466:					
Baked beans	26.29	[a]1.89	12.82	21.10	12.45
Other vegetable food	40.97	[b]49.85	86.54	32.02	71.37
Total vegetable food	67.26	51.47	99.36	53.12	83.82
Total animal food	32.74	48.32	.64	46.88	16.18
Digestion experiment No. 467:					
Baked beans	32.54	[a]2.00	17.71	22.75	15.88
Other vegetable food	36.36	[b]37.78	81.64	30.78	60.42
Total vegetable food	68.90	39.78	99.35	53.53	76.30
Total animal food	31.10	60.22	.65	46.47	23.70
Digestion experiment No. 468:					
Baked beans	19.69	[a]1.52	11.53	15.13	10.07
Other vegetable food	38.07	[b]46.13	87.53	35.16	68.15
Total vegetable food	57.76	47.65	99.10	50.29	78.22
Total animal food	42.24	52.35	.90	49.71	21.78

[a] Not including fat added in the form of pork.
[b] Including fat from animal sources used in preparation of food.

As will be seen, the animal foods furnished from about one-third to one-half of the protein and from about one-fifth to nearly one-half of the energy of the diet. Correspondingly, vegetable foods furnished on an average rather more than one-half of the total protein and considerably more than one-half of the total energy. Baked beans were the most important single food, furnishing from one-fifth to one-third of the total protein and from one-tenth to one-seventh of the total energy of the diet.

NUTRIENTS EATEN PER MAN PER DAY IN THE DIGESTION EXPERIMENTS.

Throughout the periods covered by the different digestion experiments the kinds and amounts of food eaten by each subject were of course recorded, so that the digestion experiments may be regarded as dietary studies also. They differ from the other dietary studies with Maine lumbermen in that the records are made for a single individual instead of for a group. Digestion experiments Nos. 463 to 465 were made at the same time as dietary study No. 393—while the men were engaged in cutting and yarding logs. Digestion experiments Nos. 466 to 468 were made at the same time as dietary study No. 394—while the men were at work drawing logs from the yard to the landing. The quantity of nutrients and energy in the food eaten per man per day during the digestion experiments and the corresponding dietary studies are shown in Table 29, which follows. For convenience in tabulating the records, the digestion experiments are here numbered as dietary studies in series with the other dietary studies.

TABLE 29.—*Comparison of nutrients and energy of daily diet in digestion experiments and dietary studies with Maine lumbermen.*

Kind of work.	Quantities per man per day.			
	Protein.	Fat.	Carbohydrates.	Fuel value.
CHOPPING AND YARDING.	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Digestion experiment No. 463 (dietary study No. 395)	175	226	757	5,710
Digestion experiment No. 464 (dietary study No. 396)	206	244	708	6,780
Digestion experiment No. 465 (dietary study No. 397)	212	248	927	6,760
Average	198	239	797	6,415
Dietary study No. 390	247	386	944	8,199
Dietary study No. 393	176	388	982	8,085
Average	212	387	963	8,140
DRAWING LOGS TO LANDING.				
Digestion experiment No. 466 (dietary study No. 398)	175	181	958	6,075
Digestion experiment No. 467 (dietary study No. 399)	156	189	768	5,330
Digestion experiment No. 468 (dietary study No. 400)	147	163	672	4,665
Average	159	178	799	5,355
Dietary study No. 391	179	336	769	6,782
Dietary study No. 394	180	316	839	6,888
Average	179	326	804	6,835

In the discussion of the results of dietary studies with the lumber crews as a whole, it was pointed out (p. 31) that the food consumption was larger during the period of severe work of chopping and yarding than during the period of less severe work of hauling logs to the landing. The same is also true for the individuals included in the digestion experiments. Thus it will be seen from the figures above that the minimum for the three subjects of studies during the period of harder work, 175 grams of protein and 5,710 calories of energy, was equal in protein, but a little lower in energy than the maximum, 175 grams and 6,075 calories, during the period of less severe work. The average consumption for the three subjects in the former period was 198 grams of protein and 6,415 calories of energy, as compared with 159 grams and 5,355 calories for the three subjects during the latter period.

The particular interest in the data summarized in the table above, however, is in the comparison between the results of the studies with individuals and those of the corresponding studies with groups during the same period.

While the men were chopping and yarding the quantity of protein in the diet of the three individuals ranged from 175 to 213 grams per man per day, and averaged 198 grams, whereas the average for the group in the dietary study (No. 393) made at the same time was 176 grams. On the other hand, the quantity of energy per man per day ranged from 5,710 to 6,780 calories, and averaged for the three men 6,415 calories, as compared with 8,085 calories for the group. Thus while each of the three individuals consumed as much or more protein than the average for the group, they obtained considerably less energy, because of the smaller amount of fats and carbohydrates eaten. The quantity of fat ranged with the individuals from 226 to 248 grams, and averaged 239 grams, and the carbohydrates from 708 to 927 grams, and averaged 797 grams, whereas in the average food consumption for the group the amounts were 388 grams of fat and 982 grams of carbohydrates.

In the studies made at the time of drawing logs to the landing the quantity of protein in the food eaten by the individuals ranged from 147 to 175 grams and averaged 159 grams, whereas the amount per man per day for the group in the dietary study (No. 394) made at the same time was 180 grams. As regards energy, the range for the studies with individuals was from 4,665 to 6,075 calories, and the average 5,355 calories, as compared with 6,836 calories per man per day for the group. In this case each of the three individuals ate less protein than the average for the group. They also ate much smaller quantities of fat. As regards carbohydrates, one man ate considerably less, one only a little less, and one considerably more than was found in the average for the group.

The reason for these discrepancies between results of dietary studies with groups and those with individuals under the same circumstances is not easy to determine. As already noted, the subjects of the digestion experiments were selected because they were believed to be typical of the men in the dietary studies. They ate in the same room and at the same time with the rest of the crew, although at a separate table, and were served with the same kind of food, being allowed to select such kinds and amounts as their appetites dictated. If other men had been chosen for the digestion experiments it is possible that the agreement with the average results of the dietary studies would have been closer; but, of course, this is a matter of conjecture only. The discrepancies noted would suggest the question as to which results should be considered most representative of the normal food consumption of the men under the conditions of these investigations. It is quite generally believed that the values per man per day as obtained in dietary studies with large groups more nearly represent the requirements of the average individual in the same circumstances than do the results obtained with a single individual considered a fair representative of the group, though there are those who believe that the experimental conditions may be more carefully controlled and that thus greater accuracy is possible when the experiment is limited to a single individual. In this instance, however, both dietary studies and digestion experiments were carefully made, and the results in both cases are believed to be reliable. It is believed also that all the men consumed as much food as they needed. In such a case the inference would be that as regards amounts eaten the men selected were not as typical as was anticipated of the whole group, since the majority consumed larger quantities of fats and carbohydrates than they did. The results afford an excellent illustration of the difficulty in estimating food consumption without actual weighing.

CONCLUSIONS.

These dietaries of Maine lumbermen are, as regards protein and energy, the highest yet recorded for any class of American laboringmen, with the exception of a very small number reported for teamsters and brickmakers at severe labor. The large amounts of food eaten must be attributed in great part to the severe labor in the open air and the cold to which the men were exposed.

Whenever the labor was less continuous, as in the case of the teamsters when engaged in hauling for long distances, the amount eaten became noticeably less. Although the work of river driving is severe, calling for long days and often obliging the men to work while wet with icy water, yet it was found that under these conditions they ate less than when cutting in the woods. This was probably due in part to a less varied diet and in part to the unfavorable conditions under which the food was eaten. In the case of the men engaged in chopping and yarding the amount of protein consumed was considerably in excess of that called for by the commonly accepted dietary standard. The energy furnished by the same dietaries was also far in excess of the amounts called for by the standard for very hard muscular work. Since these conditions were not accompanied by any increase in the weight of the subjects, it is not probable that the diet was greatly in excess of their needs.

The cost of food per person per day during these experiments ranged from 15.1 to 28.6 cents and averaged 23.5 cents. On an average about two-thirds of the total expenditure was for animal food and about one-third for vegetable food.

In the digestion experiments the results obtained with the different subjects were on the whole very uniform, the protein and other nutrients being in all cases quite thoroughly digested and about 93 per cent of the energy of the diet being available. Considered as a whole the results agree quite closely with the average values obtained in a large number of American experiments made under widely varying circumstances. As has been observed in other experiments, when corrections for metabolic products, obtained by the pepsin method, are introduced the coefficients of digestibility of protein are higher than when the corrections are obtained by the ether, alcohol, and limewater method.

During the digestion experiments it was found that animal foods furnished from about 33 to 50 per cent of the protein and from about 20 to nearly 50 per cent of the energy of the diet. Baked beans furnished from 20 to 33 per cent of the total protein and from 10 to 14 per cent of the total energy of the diet.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 150.

A. C. TRUE, Director.

DIETARY STUDIES AT THE GOVERNMENT HOSPITAL FOR THE INSANE, WASHINGTON, D. C.

BY

H. A. PRATT AND R. D. MILNER.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 150.

A. C. TRUE, Director.

DIETARY STUDIES AT THE GOVERNMENT HOSPITAL FOR THE INSANE, WASHINGTON, D. C.

BY

H. A. PRATT AND R. D. MILNER.

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OFFICE OF EXPERIMENT STATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., September 8, 1904.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 150 of this Office, a report of dietary studies carried on at the Government Hospital for the Insane, Washington, D. C., by H. A. Pratt and R. D. Milner.

The investigation covers 26 studies, four of which were made with officers and attendants and the remainder with patients. These investigations are interesting as affording data for use in determining dietary standards and also have a decided practical value, since the knowledge gained by a study of food conditions made it possible to suggest improvements in the institution diet which were immediately carried out, with the result that a considerable saving was possible without in any way lowering the quality of the diet. In plan and scope these investigations were very similar to those which were carried on for the New York State Commission in Lunacy by Prof. W. O. Atwater, chief of nutrition investigations, and the study forms a part of the investigations on the food and nutrition of man conducted under his immediate supervision. The statistics were gathered by Mr. Pratt and the calculations were made under the supervision of Mr. Milner. In planning the details of the investigation Mr. Pratt was in frequent consultation with Dr. C. F. Langworthy of this Office. Mention should be made of assistance rendered by Mr. A. B. Albro in the preparation of the report.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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DIETARY STUDIES AT THE GOVERNMENT HOSPITAL FOR THE INSANE.

INTRODUCTION.

The series of studies herein reported were made at the U. S. Government Hospital for the Insane, which is situated on the Anacostia River, on an elevation overlooking the city of Washington, D. C. This institution is designed primarily for the benefit of persons who have become insane while performing Government duty as soldiers and sailors, although all the insane of the District of Columbia are also committed there.

The hospital seemed especially well adapted for carrying on dietary studies because, as explained below, the patients were of an exceptionally good class. In similar investigations at other institutions it has been found especially difficult to obtain correct data where the patients were violent or hostile. The interest in such work manifested by Dr. A. B. Richardson, who was then superintendent of the hospital, made it possible to undertake this series of investigations, in which the Government Hospital and the Office of Experiment Stations cooperated, and the experimental work was very largely carried on during the fiscal year 1902–3. Doctor Richardson's death occurred before the results were finally prepared for publication. His successor, Dr. W. A. White, recognized the importance of the work undertaken and gave it his active support. A summary of the investigations reported in this bulletin has appeared in a report of the hospital.[a]

PATIENTS.

The institution had at the time about 2,200 patients, of whom 1,675 were men and 525 were women. The majority of the men patients were soldiers and sailors, a large number being veterans of the civil war. The women were very largely patients committed from the District of Columbia. The general class of male patients of this institution differed in several respects from the average found in State institutions. First, they were very largely men who have become incapacitated in military service; that is, they came from a body of men who were chosen originally because of good physical condition. Again, they seemed to be, as a rule, patients of rather a milder type than is generally found in State hospitals, the proportion of violent and untidy patients being comparatively small. They appeared also to be rather above the average as regards education and general intelligence. The women patients were of about the same class as is found in most public institutions of a similar character.

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[a] Rpt. Govt. Hospital Insane 1903, p. 7.

In general, it might be expected that the patients here would be better clothed, better fed, and have more comforts and privileges than patients in State institutions, a large proportion of whom are paupers, and such was believed to be undoubtedly the case. Taken as a whole, it may be said that the amount of work done by the patients in this institution was smaller than that in the public State hospitals. The institution, however, makes a large quantity of clothing and mattresses, but no goods are made for sale outside the hospital, and much of the work which, in other institutions, is commonly done by patients is done here by hired helpers. Moreover, a large number of the patients who do work receive wages, which is not generally the case in similar institutions elsewhere in the United States.

OFFICERS AND ATTENDANTS.

The officers and attendants of the institution numbered about 660, of whom about 215 were women. The staff of attendants is well ordered and organized and seems to be particularly well fitted for the care of the patients. The school for trained nurses furnishes thoroughly competent men and women nurses, while there can be no doubt as to the high ability of the physicians in attendance.

Too much credit can not be given to the attendants and subofficers for the kind and careful assistance rendered during the progress of these studies. It was gratifying to feel that the cooperation of the whole force could be relied upon and that they were genuinely interested in the success of the studies. The kitchen help also rendered most efficient and willing service.

HOSPITAL BUILDINGS.

The grounds of the institution are large and very beautifully laid out. The hospital buildings are modern, and at the time of the investigations consisted of the following: The Toner group, comprising the Toner and Oaks building and the Toner general kitchen; the Howard Hall department, comprising Howard Hall, West Lodge, and the annex building; the west side department, comprising all the male wards situated in the Garfield, Dawes, and center buildings; the east side department, which had the care of all the female patients of the institution; the Allison buildings, for sick and decrepit patients; and the detached buildings department, which comprised a number of buildings accommodating some 600 men. Besides the buildings for patients there was a general kitchen and steam power house, an electric power house, a storeroom, a laundry, and various trade shops, such as a carpenter's shop, blacksmith's shop, and others, where such patients as it seemed desirable were employed. In addition to these a number of new buildings have recently been completed.

There were in the whole institution about 70 wards, 57 for men and 13 for women. There were also a large number of dining rooms for attendants, outside help, and colored employees, besides the private quarters of the various heads of departments.

THE STOREROOM AND KITCHENS.

When supplies ordered for the institution are received they are placed at once in the general storeroom, or "store," as it is called. This is organized on somewhat the plan of a department store, there being a grocery department, a meat department, and a tailoring and clothing department, each under a separate head. When any kitchen, ward, dining room, or other department of the hospital desires that a given article be disbursed to it, the head of that department fills out a blank stating the article desired, which blank is placed in the hands of the storekeeper, who issues or directs the issue of the article, the blank being signed and filed with the bookkeeper. From these blanks are made up the ledgers, which show the quantities of foods disbursed to the different kitchens.

The "general kitchen" is the largest at the institution, and, except for those in the Toner, Allison, and "detached buildings" departments, supplied food for the whole institution. It is situated close by the general storeroom, or store, and contains, besides the kitchen proper and the scullery, the bakery and two dining rooms. The building is approximately in the center of the half circle of buildings which are supplied from it. Nearly all the food is sent out through tunnels on cars to the different dining rooms and wards.

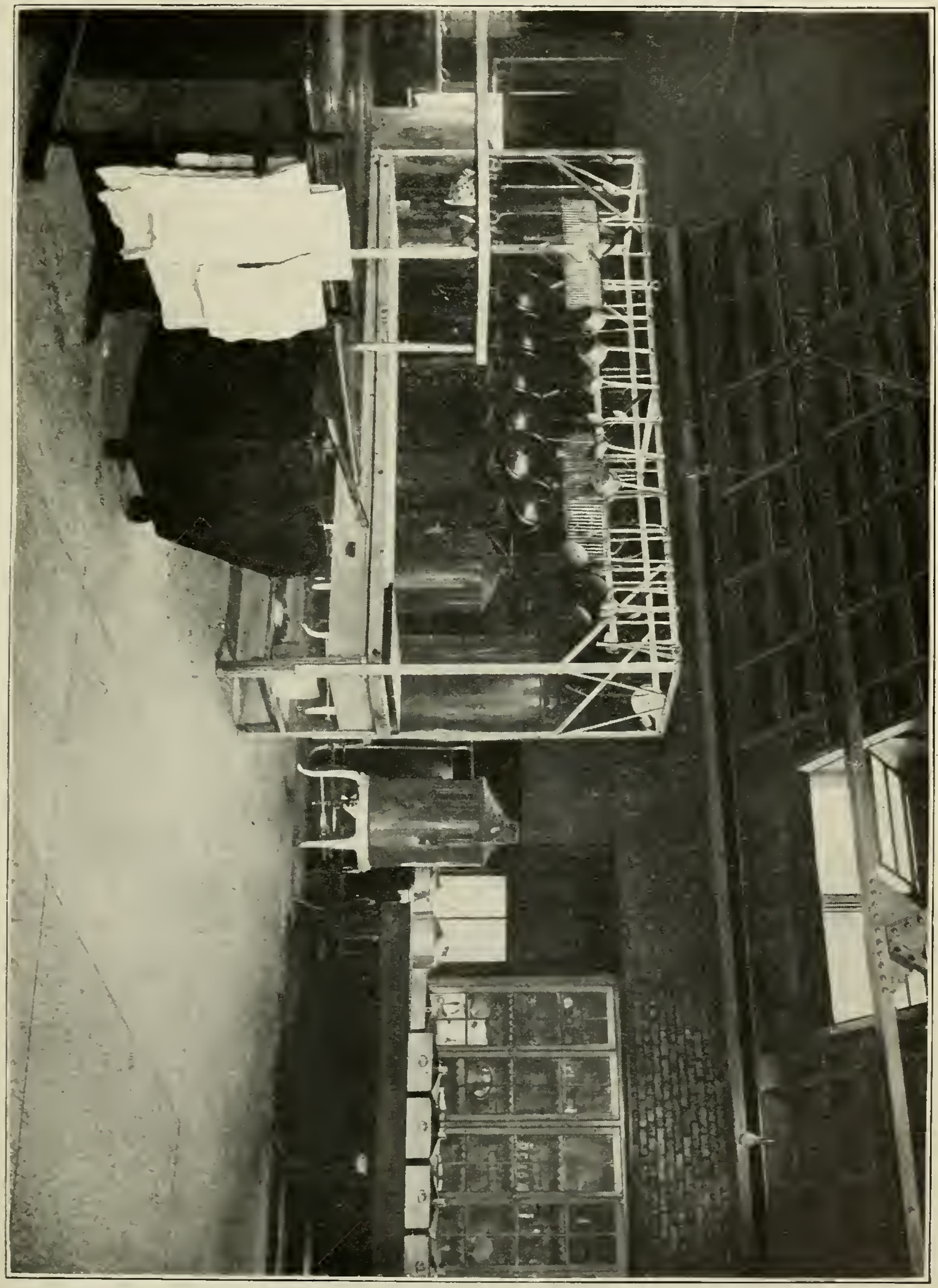
The kitchen itself is in the second story of the building and is of considerable size. It is equipped with nine vegetable steamers, two large and five small steam kettles, two ranges, one of six and one of four ovens, the smaller of which is set apart for the use of special cooks for the preparation of special meals, and a large oven used for baking beans, fish, and quick biscuit. All the steamers and kettles are heated by steam. Besides the above there are four large steam kettles on the ground floor. The large rooms on this floor serve for a vegetable storeroom and scullery and for the preparing of meats and washing of the kitchen utensils.

At the right of the kitchen proper, on the second story of the building, is a bakery which supplies bread, cake, biscuit, and pies for the entire institution. This department appeared to be well adapted to the needs of the institution. Good materials were used, the work was done under the supervision of competent bakers, and the quality of the foods prepared was found to be excellent. The butcher shop, where meat is cut up, is in a part of the general storeroom and directly adjoining the kitchen.

The "detached kitchen" proper (Pl. I) is situated on the second floor of the building, there being a scullery and an attendants' dining room on the first floor. In addition to the cooking done for patients, part of the kitchen was in charge of a special cook, who prepared the food for the attendants of this section. The kitchen is abundantly supplied with modern apparatus and utensils. It has a large range, six ovens for baking, roasting, and frying, and kettles and coppers heated with steam for boiling, stewing, and making coffee, tea, etc. The kitchen is in charge of a dietitian, who superintends the cooking and has general management of the kitchen work. Everything in this department was in good condition, the food being cooked with more than usual care. Attention was given to seasoning and flavoring the different foods to a greater extent than has been observed in some similar institutions.

The "Allison kitchen" is situated in the basement of the "Allison A building." Besides the room used for cooking there are a small storeroom for food and another small room used for the storage of cooking utensils, dishes, etc. The kitchen is so far from the general storeroom that the provisions are sent to it only once each day. Two departments, viz, the family of one of the resident physicians and a group of about 100 male patients—nonworkers, mostly chronic sick, infirm, aged, and decrepit—were supplied by this kitchen. The food for the family mentioned was prepared by a special cook, but the same range was used as for the patients' food. On three sides of the kitchen are the three buildings, Allison B, C, and D, and food was sent from the kitchen through tunnels to two wards in each, namely, B1 and B2, C1 and C2, and D1 and D2. Food was carried out through the tunnels on cars to dumb-waiters in the basements of the wards and was raised to the several dining rooms. The section of the tunnel in front of the kitchen was used as a scullery and vegetable cellar. The kitchen force consisted of three colored cooks—two women and one man—and three working patients. A dietitian had charge of this kitchen.

The "Toner general kitchen" is situated between the Toner and Oaks buildings and, with them, comprises the Toner group, being connected with these buildings by tunnels. It is one story in height and is very unsatisfactory in design, as an immense stack and brick flues divide it nearly in half. This kitchen was not so well equipped as the others, having but one steamer for vegetables and one steam kettle, the rest of the cooking being done on a range of three ovens.



Detached Kitchen, Government Hospital for the Insane.

In this kitchen food was cooked for four groups, as follows: (1) Attendants and employees, male and female; (2) patients and help; (3) sick and bedridden patients, and (4) paying patients receiving a special diet. The kitchen force included two cooks, five assistants, and three working patients, and was in charge of a competent dietitian. This kitchen is soon to be replaced by a new one, hence no effort has been made lately to better the equipment. The food was well cooked and seasoned and the articles served were wholesome.

SYSTEM OF FEEDING.

The system of feeding the patients in this institution provides for three meals each day, served approximately at 7, 12, and 5 o'clock. Hot bread is served with breakfast each day. The dinner, which is served at noon, is of course the heartiest meal, and the supper is, as a rule, a rather light meal.

Six classes of meals were prepared at the institution, designated as "officers' diet," "first section's diet," "attendants' and employees' diet," "regular patients' diet," "sick diet," and "special diet." Since all but the first of these were served in the course of the studies, a brief explanation of the remaining five may be given here.

The "regular patients' diet" is that provided for the patients of the institution as a whole, and is illustrated by the menus given in connection with studies Nos. 364 and 367 on pages 20 and 34. The "attendants' and employees' diet" is of somewhat similar character, but differs in several respects in that it is prepared by special cooks, is cooked in smaller quantities, and comprises a larger proportion of such kinds of food as soups and desserts than the regular diet. This is illustrated by the menu given in connection with study No. 365 on page 24. It is the intention to arrange the menus so that the same kind of food shall not be served to patients and employees at the same meal, since the employees might lack appetite for the kind of food which they had served to the patients just before coming to their own meals.

The "first section's diet" is that provided for paying patients and others receiving special treatment. In general it was somewhat more varied than that of the attendants and employees, having, for instance, soup and dessert with each dinner. The food is cooked separately for the most part, but a few articles, such as oatmeal, are cooked together for all diets. A sample menu showing this diet is given in connection with study No. 387, page 67.

"Sick diet" and "special diet" were such as would be indicated by the designations. The former was that provided for the sick and decrepit, as shown by the menu for the study No. 366, page 30, supplied by Allison kitchen, which supplies such patients. The special diet or extra diet is that furnished according to the special orders of the physicians in charge and is prepared by the cooks who provide the "sick diet." It consists of special foods for special cases. An example of this kind of diet is given in connection with study No. 371 on page 28.

In general the system followed in this institution provides for a change of menu each month, the menu selected covering seven days, and being repeated throughout the month. Important changes in the menu are made at the beginning of each month, when it is intended that a practically new menu shall be used. Of course a continual repetition of some staple articles is unavoidable, but, wherever possible, changes are made. Thus fresh vegetables and fruits in their season are supplied to the patients, and during the cold weather pork is often served in place of beef, the staple meat, and in their season shad and fresh herring take the place of other animal foods to a reasonable extent. It will be seen that while the food is necessarily simple in character, an attempt is made to vary the diet.

THE DIETARY STUDIES.

The investigations conducted at the Government Hospital included an examination of the statistics of the food supply with regard to the kinds, amounts, and nutritive value of the materials; determinations of the amounts and nutritive value of food actually consumed and rejected by different classes of the hospital population; and observations of the methods of handling, cooking, and serving the food.

During the period from September 1, 1902, to July 1, 1903, the experimental data were gathered for 28 dietary studies, of which 26 are here reported. These studies give data concerning the food consumption of about 1,570 male patients and 130 employees, though only 4 of the 26 studies were made with the latter. The studies with the male patients include almost the total male population of the hospital who were in a fair degree of physical health and also some sick patients. The studies with the attendants, however, include but a relatively small proportion of their total number. No studies were made with female patients. These comprised a minor portion of the total population, and for this reason and since lack of time forbade studies of the whole institution, it was deemed best to give preference to such studies as would, if possible, represent the whole male department. Each of the studies made covered one week, a period which has been found convenient and long enough, it is believed, to give a fair idea of the food consumption of any class, especially as the menu is practically the same for each week of any given month. It would have been interesting to duplicate some of the studies, since this would have furnished a check on the data here given. However, the studies were carried on with extreme care, and it is believed that the data obtained are at least sufficiently accurate for all practical purposes. The results of these studies are given on pages 19 to 71 and in Table 35 of the Appendix.

Preliminary to the experimental work statistics were compiled regarding the food supply of the whole institution. These are given in Table 36 of the Appendix and summarized on page 72. These statistics are for the fiscal year just preceding the time of the dietary studies, and consequently do not strictly apply to the time during which the studies were made. Unfortunately, when the studies were completed there was no opportunity to compile similar data for the year in which the studies were conducted, but from a cursory examination of the accounts it seemed fair to consider that the supplies for the two years did not differ materially in actual nutritive value.

EXPERIMENTAL METHODS.

Previous publications of this Office[a] have given detailed discussions of the composition and nutritive values of food, the functions of the different nutrients, the objects and methods of making dietary studies, etc. The following summarized statements will therefore suffice here:

Food is useful to the body only so far as it supplies to it the materials which it uses for growth and for repairing its wastes, replacing worn-out tissues, and supplying energy for muscular work. The materials so used are protein or nitrogenous material, fats, carbohydrates, and various salts. In addition the body requires the oxygen of the air, and water, which, though necessary for physiological reasons, is not usually called a nutrient. Some or all of these nutrients are present in all foods, though occurring in varying forms and proportions in different materials. Just how the different nutrients are used in the body in all cases may be somewhat uncertain, but it seems undoubtedly true that under ordinary conditions protein is used for building up and repairing muscular tissue, while the fats and carbohydrates, together with the surplus of protein, are oxidized to yield the energy for motion and muscular work; though if the quantities of nutrients are larger than are immediately needed the surplus may be stored in some form (chiefly fat) for future use. Salts are useful for forming bone and other parts of the body and are doubtless used in other ways also.

The final object of a dietary study is in brief to determine the quantities of nutrients and energy in the diet of a given number of persons for a definite period. The usual method of conducting a dietary study, in a family for instance, includes (1) determinations of the amounts of all the different food materials in store at the beginning of, purchased during, and remaining on hand at the end of the period of study; (2) determinations of the kinds and amounts of kitchen and table wastes, with analyses where practicable; and (3) a record of the weight, age, sex, and occupation of the different members of the group, and the number of meals taken by each. From these statistics, and data regarding the composition of the food materials, as determined by analyses of samples of materials used or as assumed from previous analyses of similar materials, the total amounts of protein, fats, and carbohydrates in the diet and the average amounts consumed per man per day are computed.

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[a] See list on cover.

In carrying out the studies here reported some modifications of this method were necessary. For instance, separate studies were made with different groups of the hospital population. Obviously, this could not be done by taking account of the amounts of food materials brought into and issued from the hospital storeroom from which all the kitchens were supplied, which would correspond to the method usually followed in a study with a family. Nor was it practicable to study the food consumption of a given group by determining the quantities of food brought into the kitchen in which the meals for the group were prepared, because in each kitchen food was prepared for several groups at once, whereas commonly but one group could be studied at a time. Data regarding the food consumption of each group were therefore obtained by taking account of the food used in the dining room in which the group was fed.

In each study all food sent from the kitchen to the dining room was weighed, as well as all not served which was returned to the kitchen after meals. After each meal the wasted food, which comprised that remaining upon the plates, which was never served again, and in some cases also that left in the serving dishes, was carefully scraped into receptacles and also weighed, each kind of food being kept by itself. The separation of the waste into the different kinds of food proved to be a matter of some considerable difficulty, for the reason that where a number of articles of food are served on the same plate the uneaten portions are apt to become more or less mixed and hence difficult to separate satisfactorily.

The figures obtained by the above-mentioned weighings give for each article the amount served, the amount returned, if any, and the amount wasted, thereby furnishing the data for determining the amount consumed. These statistics are recorded for the different studies in Table 35 in the Appendix.

The waste just referred to consisted of actually edible material that was rejected. In addition some foods contained inedible material or refuse, such foods being fish and meat containing bones, prunes containing pits, etc. The amount of such refuse was determined in each case, because such data were necessary in the computations of the quantities of nutrients in the food consumed, as hereafter explained.

The next step, that of ascertaining the amount of protein, fat, and carbohydrates in the amount of food consumed, demands particular consideration, as it differs from the methods which have been commonly followed in connection with dietary studies made in the household. If the percentage of protein, fat, and carbohydrates in every article that was weighed had been known, the determining of the amounts of nutrients in the food consumed would have been only a matter of calculation. Such, in fact, was the case for any foods that were eaten without cooking, as, for instance, some of the fruits. The average composition, in the uncooked state, of most food materials in common use in this country is quite well known from the results of a large number of chemical analyses. But it will be observed that the data of amounts served, obtained as explained above, are nearly all for cooked foods, and very little is definitely known regarding the composition of cooked foods. Even if a large number of analyses of cooked foods were available they would not be of much advantage, because the method of preparation of any cooked dish varies in individual cases in regard to the amounts of the several food ingredients used, the amount of water added, the length of time of cooking, etc., all of which factors influence directly the percentage composition of the cooked article.

The best method of determining the composition of the foods used would, of course, be to analyze a sample of each, but the labor and expense involved would be great and no laboratory facilities for performing such work were at hand. This method, therefore, was not attempted. Another method for ascertaining the percentage composition of cooked foods, which has been used in a considerable number of studies made elsewhere[a] and which has given results that are believed to be reasonably accurate, consists in obtaining for any given cooked food the weight and composition of each raw ingredient used in preparing it and the total weight of the cooked article, from which data the percentage composition of the cooked food may be calculated. This method was adopted in the studies here reported and may be here briefly described.

Cooked foods may be grouped, for convenience, into three classes. The first group will include such materials as meats, which in general lose in weight during cooking, largely through loss of water or water and fat. The second class will include such dishes as boiled oatmeal, rice, hominy, etc., in which the only change in proximate composition is that due to the addition of water in cooking, so that although there is no loss of nutrients, the total amount in a given weight of the cooked food is much less than in the same weight of the raw material. The third class includes prepared dishes made up of a considerable number of raw ingredients. Thus beef stew may contain beef, potatoes, onions, carrots, parsnips, etc.; and puddings may be made of flour, drippings, butter or lard, sugar, eggs, and other ingredients. During baking, frying, or any mode of cooking, there may be a slight loss of nutrients through volatilization of fat, burning of sugar, etc., but such losses are believed to be very small. Calculating the composition of such foods on the basis of the amount and composition of the raw ingredients used necessitates the assumption that there is no very appreciable loss of nutrients in cooking, an assumption which seems justified by the fact that in a considerable number of comparisons it has been observed that the percentages of nutrients in such made dishes, as estimated by the method used in these studies, are extremely close to the percentages found by actual analysis.

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[a] New York State Com. Lunacy Rpt. 11 (1898-99), 12 (1899-1900), 13 (1900-1901).

In the case of those materials in which the total amount of nutrients is the same in the cooked as in the uncooked food, the principle of the calculation is simply one of proportion, and may be stated thus:

The weight of the cooked food is to the weight of the raw food as the percentage composition of the raw food is to x (the percentage composition of the cooked food);

Or, to put it in another way:

The total amount of nutrients being the same in the cooked food as in the raw, the percentage composition of the cooked food is to be obtained by dividing the total amount of each nutrient by the total weight of the cooked food (and multiplying by 100), since the proportion of protein, fat, or carbohydrates varies directly with the change of weight of the raw material in cooking.

In calculating the composition of cooked meat from that of the uncooked, allowance must of course be made for the fat cooked out and for bones removed. The method of making the computations will perhaps be made clearer by the following typical examples, one for each of the three classes of cooked foods described above.

The first illustration is that of meat from which fat was cooked out. A lot of corned beef weighed 799 pounds before cooking and 515.5 pounds when cooked, 56 pounds of the loss in weight being due to fat cooked out. Raw corned beef as purchased has been found by average of several analyses to contain 14.8 per cent protein and 18.1 per cent fat; hence the amounts of protein and fat in the raw beef as purchased would be 118 and 145 pounds, respectively. But since 56 pounds of fat cooked out, this must be deducted from the total amount of fat, leaving 118 pounds protein and 89 pounds fat. The meat and bones after cooking weighed 515.5 pounds, of which 114 pounds was found to be bones, leaving 401.5 pounds of cooked edible meat containing 118 pounds of protein, or 29.4 per cent, and 89 pounds of fat, or 22.2 per cent. The table following summarizes the data.

Table 1.—*Percentages and total amounts of nutrients in raw and corned beef.*

	Total weight.	Percentage composition.			Amounts of nutrients.		
		Protein.	Fat.	Carbohydrates.	Protein.	Fat.	Carbohydrates.
	Pounds.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*
Corned beef, raw, as purchased	799	14.8	18.1		118	145	
Fat cooked out	56		100.0			56	
Corned beef, cooked, as purchased	515½	22.9	17.3		118	89	
Bones removed	114						
Cooked meat, edible portion	401½	29.4	22.2		118	89	

The simplest of these computations is that for the class of cooked foods of which the following is typical:

In one case 75 pounds of uncooked wheat breakfast food was required for breakfast, which after cooking was found to have taken up enough water to make the weight 489.25 pounds. Raw breakfast food of this particular kind, as has been found by analyses, contains on an average 12.3 per cent protein, 1.8 per cent fat, and 74.2 per cent carbohydrates. Then by the proportion stated above, 489.25: 75: : 12.3: x, the percentage of protein in the cooked food, which upon solving the proportion is found to be 1.9 per cent. In the same way the percentages of fat and carbohydrates in the cooked material may be found. The data are summarized in the following table:

Table 2.—*Composition of raw and cooked wheat breakfast food.*

	Total weight.	Percentage composition.			Amounts of nutrients.		
		Protein.	Fat.	Carbohydrates.	Protein.	Fat.	Carbohydrates.
	Pounds.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*
Raw cereal	75.00	12.3	1.8	74.2	9.23	1.35	55.65
Cooked cereal	489.25	1.9	.3	11.4	9.23	1.35	55.65

As illustrating the method of calculating the percentage of nutrients in made dishes containing a large number of articles, the following may be cited:

A bread pudding weighing when cooked 228.5 pounds was used in one of the studies and contained, besides flavoring, the following articles: Currants (dried), raisins, sugar, eggs, evaporated cream, butter, bread. The amount of the several ingredients, the percentage composition of each, and the quantity of nutrients each would furnish are shown in the following table:

Table 3.—*Proportion and amount of nutrients in articles used in making bread pudding.*

	Amount used.	Percentage composition.			Amounts of nutrients.		
		Protein.	Fat.	Carbohydrates.	Protein.	Fat.	Carbohydrates.
	Pounds.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*	*Pounds.*	*Pounds.*
Currants, dried	4.8	2.4	1.7	74.2	0.1	0.1	3.5
Raisins	1.5	2.3	3.0	68.5			1.0
Sugar	20.5			100.0			20.5
Eggs as purchased	6.0	13.1	9.3		.8	.6	
Evaporated cream	7.5	9.6	9.3	11.2	.7	.7	.8
Butter	3.9	1.0	85.0			3.3	
Bread	46.5	9.2	1.3	53.1	4.3	.6	21.7
Total					5.9	5.3	50.5

The composition of the cooked pudding was computed as protein 2.6 per cent, fat 2.3 per cent, and carbohydrates 22.1 per cent, by dividing the total quantity of each nutrient given in the table above by 228.5, the weight of the pudding when cooked and multiplying by 100, the assumption being that there would be no appreciable loss of nutrients in cooking.

Obviously considerable labor was involved in making weighings of the raw foods used in preparation of the different dishes. In dietary studies Nos. 364, 365, and 371 these weighings were made for all foods served at each meal, but in the other studies, which were made in dining rooms supplied from the larger kitchens, this was not practicable, for the reason that the cooking was done for a large number of dining rooms at the same time, and the food for one dining room could not be separated from that for the others. In order to obtain data for computing the composition of the cooked foods under such circumstances it was necessary to weigh the raw ingredients used in preparing food for all the wards supplied from the kitchen, and the number of weighings involved for such a simple dish as boiled cabbage, for example, was from 40 to 60, so that one observer could not collect data for all the foods used at each meal, in addition to gathering those for food served, returned, and wasted in the dining room. It was therefore necessary in all other studies than the three just mentioned to reduce to a minimum the labor of collecting statistics in the kitchen.

It was observed that for any given dish the cooks would use practically the same quantities of raw ingredients each time, and that the other conditions, namely, the amount of water added and the time of cooking, were generally the same; under such conditions any given dish made in the same kitchen at different times was quite uniform in character. The composition as computed at different times was likewise quite uniform, the variations being generally no greater than in the analyses of different samples of the same kind of food material. It was therefore believed to be sufficiently accurate to compute the composition of each cooked food in most cases but once for each kitchen, and use the computed value for all studies in which the particular food was served, though in some instances a number of such determinations were made for the same food, and average values used.

All data regarding percentage composition of raw food materials were taken from a previous publication[a] of this Office giving average values for American food materials. The composition of each cooked food as computed according to the method described above is given in Table 37, and the data by which the computations were made in Table 38 of the Appendix. By use of these data and the statistics regarding the quantities of food consumed the amounts of each nutrient in the different kinds of food used were computed.

It is the usual custom to express the results of dietary studies in terms of nutrients and energy per man per day. During each study an accurate account was kept of the total number of persons served at each meal, and from these records the equivalent number of men for one day was calculated. In the studies in which both men and women were included the number of meals taken by women were computed to the equivalent number per men by assuming that one meal for a woman is equivalent to 0.8 meal for a man.

Dividing the total quantity of each nutrient consumed in each study by the number of days for one man computed as just explained gives the equivalent amount of the nutrient for one man for one day. The fuel value of the diet, that is, the amount of available energy it would furnish, was computed from the quantities of nutrients per man per day on the assumption that each gram of protein and carbohydrates would furnish 4 calories and each gram of fat 8.9 calories.[b]

The details of the dietary studies follow.

DIETARY STUDY NO. 364—CHRONIC MALE PATIENTS.

This study was made with about 550 male patients, who were nearly all chronic, mostly from middle life to old age, and appeared to be fairly quiet and orderly. Many of them were veterans of the civil war. The larger number of these patients were fed in one dining room; but in addition to these the study also included about 35 patients of a similar class, who were crippled or lame to such an extent that they could not climb the flight of steps to the larger dining room, and were therefore fed apart in a section known as "Home ward," though they received the same diet as the others.

The majority of the men in this study did no work and appeared to take very little exercise. However, 120 were classed as workers, though only a part of these did anything except very light work, many of them being employed a few hours each day in the wards or dining room.

The study began with breakfast, Tuesday, September 30, 1902, after preliminary observations of 1 day, and continued for 7 days, with 21 meals. In the preliminary period the only food weighed was that for supper, but the different kinds of food in the material rejected were separated and an attempt was made to determine clearly just what was desired in carrying on the study. An accurate census of the patients at each meal showed the total number of meals taken to be 11,353, which was equivalent to 1 man for 3,784 days.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.

[b] See Connecticut Storrs Station Rpt. 1899, p. 104.

The food consumed in this study was prepared in the "detached kitchen," described on page 10, which directly adjoins the large dining hall in which these patients were served. This hall is neat and clean, large, and well heated and ventilated. The patients are served by the attendants and, owing to the nearness of the dining room to the kitchen, the food comes to the tables fairly hot, which makes it seem more appetizing.

During the week that this study was made the following menu was served:

TUESDAY, SEPTEMBER 30, 1902.

Breakfast.—Oatmeal, liver and bacon, rolls, butter, coffee.
Dinner.—Beef stew, bread, cabbage, bread pudding, butter, coffee.
Supper.—Bread, butter, prune sauce, tea. For workers, meat.

WEDNESDAY, OCTOBER 1, 1902.

Breakfast.—Oatmeal, beef stew, bread, coffee, butter.
Dinner.—Bean soup, corned beef, bread, eggplant, potatoes, crackers.
Supper.—Baked apples, bread, butter, tea. For workers, meat.

THURSDAY, OCTOBER 2, 1902.

Breakfast.—Oatmeal, prune sauce, coffee, butter, biscuit. For workers, meat.
Dinner.—Beef potpie, bread, vegetable soup, beets, crackers, butter.
Supper.—Baked beans, bread, butter, tea. For workers, meat.

FRIDAY, OCTOBER 3, 1902.

Breakfast.—Salt mackerel, bread, butter, coffee, potatoes.
Dinner.—Baked cod, bread, coffee, beets, cabbage, steamed pudding, butter.
Supper.—Tomato sauce, bread, butter, tea, cheese, crackers. For workers, meat.

SATURDAY, OCTOBER 4, 1902.

Breakfast.—Beefsteak, potatoes, bread, butter, coffee.
Dinner.—Vegetable soup, beef, crackers, bread, cabbage, hominy.
Supper.—Baked apples, bread, butter, tea. For workers, meat.

SUNDAY, OCTOBER 5, 1902.

Breakfast.—Oatmeal, bread, butter, coffee, baked beans. For workers, meat.
Dinner.—Roast beef, corn, potatoes, bread, butter, coffee, rhubarb pie.
Supper.—Bread, butter, apple jelly, cake.

MONDAY, OCTOBER 6, 1902.

Breakfast.—Coffee, sausage, hot biscuit, butter, potatoes.
Dinner.—Bean soup, shoulder, bread, cabbage, potatoes, crackers.
Supper.—Apple jelly, bread, butter, tea. For workers, beef.

Sugar and milk are added to tea and coffee in the kitchen.

As has been stated before, the menu is practically the same for each week of any particular month, so that the above may be considered as the regular patient's menu for the month of October.

In this study a system of tagging each lot of meat was followed, which somewhat simplified the matter of obtaining separate records of the amounts used from different cookings. This was quite essential because of differences in the percentage composition of different kinds of meat, and also because, in order to compute the percentage composition of each lot of cooked meat (see p. 16), it is obviously necessary to know the weight of fat which is cooked out, the change in weight of the bones in cooking, etc. Great care was taken to secure as accurate data of this sort as possible in these studies.

The statistics regarding the total amounts of food sent from the kitchen to the dining room, the amounts served to the patients, and the amounts rejected and wasted in this study are given in detail in Table 35 of the Appendix.

The following table shows the amounts of the various nutrients and the energy in the food actually eaten, as calculated per man per day, together with the amounts of nutrients and energy wasted, for the different classes of food and for the whole ration. It should be stated that, as shown by the menu above, in addition to the regular diet served to the whole group in this study the working patients were given a little extra meat at supper, in accordance with the custom of the institution. In computing the results given in the following table, however, this extra meat has been included as if forming a part of the total food for the whole group and served to all alike. This does not appreciably affect the results, because the amount of extra food for such a small proportion of the patients was very small as compared with the total food for the whole number of patients in the study.

TABLE 4.—*Nutrients and energy in food eaten and wasted in dietary study No. 364.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	17	21	....	255	2	2	....	26
Pork	8	17	....	183	....	1	....	9
Fish	3	2	....	30	1	1	....	13
Butter	....	38	....	338	....	....	....	....
Cheese	4	5	....	61	....	....	....	....
Evaporated cream	1	1	2	21	....	....	....	....
Total animal food	33	84	2	888	3	4	....	48
Cereals	35	10	213	1,081	4	1	23	117
Sugars, starches, etc	....	1	59	245	....	....	....	....
Vegetables	11	6	55	317	1	....	7	32
Fruits	....	....	30	120	....	....	4	16
Total vegetable food	46	17	357	1,763	5	1	34	165
Miscellaneous	9	11	25	234	1	1	1	17
Total food	88	112	384	2,885	9	6	35	230

The results of the study as summarized in the table above show that the food actually eaten by the patients in this group furnished on the average 88 grams of protein and 2,885 calories of energy per man per day. As explained above, only 120 of the 550 persons studied did any work, and only a part of these did what could be considered a fair day's work; the large majority had little or no muscular exercise; so it is believed that the results of this study may be fairly compared with the commonly accepted American dietary standard for men in health with little or no muscular exercise, which calls for 90 grams of protein and 2,450 calories of energy per man per day. According to this comparison these patients would appear to have been sufficiently nourished. In support of this it may be stated that the physicians in charge considered that they were in good physical health. Many of them gained in weight after they were admitted to the hospital, while only a few lost weight. The general appearance of the men also indicated that the amounts of food consumed were sufficient for their proper maintenance.

Another indication that the food consumed was adequate is found in the amounts of food rejected. The figures in the table above show that the amount of edible food left on the plates and in the serving dishes was enough to supply 9 grams of protein and 230 calories of energy per man per day. It will be remembered that this represents food which the patients could have eaten if they had not been satisfied without it.

Statistics concerning the amounts of individual foods wasted are included in Table 35 of the Appendix, the last column of the table showing what proportion of each food provided was rejected. Apparently breakfast cereals were not relished by these patients, as about 22 per cent of the oatmeal and 47 per cent of the hominy provided were not eaten. Comparatively large amounts of beef stew and bean soup were also rejected. The figures for the whole study show that 7 per cent of the animal food and 11 per cent of the vegetable food, or 10 per cent of the total food provided, was wasted. The major portion of this consisted of material left on the plates by the patients, though some of it was material that had not been served. When the food left in the serving dishes was small in amount it was added to that rejected by the patients, but when the amount remaining after the patients were served was large it was sent back to the kitchen. The amounts thus returned are shown in the second column of Table 35 of the Appendix. During the course of this study the only articles returned were corned beef, potatoes, apple jelly, and rhubarb pie. Little or no provision was made, however, for the utilization of such "left-over" material, and most of it, particularly vegetable food other than potatoes, eventually was added to that rejected in the dining room and like other waste was used to feed pigs. The proportion of the total food provided that was actually wasted was therefore somewhat larger than is shown by the figures in the last column of Table 35.

The proportions of rejected food noted in this study do not differ greatly from what has been found in similar studies elsewhere, and in comparison were by no means excessive. Nevertheless, a part of it could have been prevented. In the first place, where the conditions of the patients are such as to unfit them for judging of their own needs, the amount of food to be served to the individual must be decided by the attendants, and they could serve the different patients in their charge in accordance with an estimate of their needs as based to some extent on observations of their food consumption. It is believed that, if judgment were thus exercised by the attendants serving the food, the amounts rejected in cases like the above would be greatly lessened.

This would result in more than a reduction of the amount of material left on the plates by the patients, for with a better knowledge of the amount of food needed it would be possible to regulate accordingly the amounts sent from the kitchen to the dining room, so that there would be a corresponding decrease in the proportion of the food remaining after the patients had been served. In this way a considerable saving could have been made in the cost of feeding the patients included in this study under the conditions then existing.

A substitution of equally nutritious and better relished foods in place of the cereal foods and stews rejected in such large quantities could also have been made without increasing the cost of the diet. Aside from these matters there seemed little need for other changes. As regards the substitution of cheaper foods of equal nutritive value for those of higher cost, it is the impression of the observer that very little could have been done in this particular case, the conditions in this study being apparently very satisfactory in this respect.

It may be stated that the observer obtained very favorable impressions regarding the cleanliness and wholesomeness of the food and the variety of the diet served. He was constantly in the kitchen during the study and noticed that the kitchen utensils were clean, the dishes were thoroughly washed, and the floors, tables, etc., were in good condition. Nearly every article served to the patients was tasted by the cooks, to learn whether it was properly cooked and seasoned. While the diet was on the whole rather simple, there was considerable change in the staple foods from day to day, and accessories such as fresh fruits and vegetables in their season were used. It appeared upon inquiry that nearly all of the patients who were competent to judge were well satisfied with their food, very few complaints being made regarding it.

DIETARY STUDY NO. 365—ATTENDANTS AND KITCHEN EMPLOYEES.

This study was made with 58 persons, chiefly male attendants, but including 14 kitchen employees, 3 of whom were women. The greater number of the kitchen help were negroes. The food, which was the same for all, was supplied from the "detached kitchen." As a rule it was cooked separately from that for the patients, though sometimes breakfast foods and meats were cooked together for both patients and attendants. The cooking for the attendants was done by a special cook and her helper, and particular care was taken to have the food wholesome, palatable, and attractive. Considerable attention was also paid to variety in the diet. It is believed that the fare compared very favorably with that of attendants in other institutions. The dining room (Pl. II), which is neat, attractive, and cheerful, is situated on the second floor of the detached kitchen building.

This study began with breakfast, October 12, 1902, after preliminary observations of 1 day, and continued 7 days, with 21 meals. The total number of persons present at different meals was very variable, owing to leave of absence granted to attendants. The total number of meals eaten during the study, estimating 1 meal for a woman as equivalent to 0.8 meal for a man, was equivalent to 1,227, or equivalent to 1 man for 409 days.

The following menu was served during this study:

SUNDAY, OCTOBER 12, 1902.

Breakfast.—Wheat breakfast food, baked beans, fried potatoes, fried ham, biscuit, coffee.

Dinner.—Baked pork with gravy, mashed potatoes, stewed tomatoes, canned peas, apple sauce, baked custard, bread, tea.

Supper.—Fried eggs, potato cakes, grapes, jelly cake, bread, tea.

MONDAY, OCTOBER 13, 1902.

Breakfast.—Oatmeal, pork sausage, corn bread, bread, coffee.

Dinner.—Boiled cabbage, boiled potatoes, pork shoulders, canned corn, cottage pudding with sauce, bread, grapes, tea.

Supper.—Cinnamon bread, hashed potatoes, dried beef, apple sauce, bread, tea.

TUESDAY, OCTOBER 14, 1902.

Breakfast.—Wheat breakfast food, liver and bacon, fried potatoes, rolls, coffee.

Dinner.—Vegetable soup, meat pie, boiled rice, boiled beets, chocolate pudding with sauce, bread, soda crackers, tea.

Supper.—Stewed pears, cold shoulder, creamed potatoes, bread, tea, quick biscuit.

WEDNESDAY, OCTOBER 15, 1902.

Breakfast.—Wheat breakfast food, beefsteak and onion gravy, biscuit, coffee.

Dinner.—Corned beef, cabbage, boiled potatoes, lemon ice, bread, tea.

Supper.—Bologna sausage, apple sauce, gingerbread, potato cakes, bread, tea.

ATTENDANTS' DINING ROOM, DETACHED KITCHEN BUILDING.

THURSDAY, OCTOBER 16, 1902.

Breakfast.—Wheat breakfast food, pork chops and gravy, fried potatoes, biscuit, coffee.

Dinner.—Vegetable soup, mutton stew, canned corn, apple pie, soda crackers, bread, tea.

Supper.—Cold corned beef, baked beans, fresh apples, bread, tea.

FRIDAY, OCTOBER 17, 1902.

Breakfast.—Cereal, fried potatoes, salt mackerel, rolls, coffee.

Dinner.—Stuffed cod, bacon, boiled potatoes, macaroni and tomatoes, stewed corn, chocolate custard, bread, tea.

Supper.—Scalloped fish, fried apples, bread, cheese, tea.

SATURDAY, OCTOBER 18, 1902.

Breakfast.—Oatmeal, beefsteak and gravy, fried potatoes, bread, coffee.

Dinner.—Boiled beef, baked sweet potatoes, cabbage, boiled rice, floating island pudding, bread, tea.

Supper.—Hash cakes, mush, stewed pears, Graham bread, tea.

Butter served with every meal. Sugar and milk always provided. Bread served ad libitum.

The detailed data regarding the total quantities of food served, eaten, and wasted during this study are given in Table 35 of the Appendix. The results as calculated to show the amounts of nutrients and energy per man per day in the food eaten and that rejected are summarized in Table 5.

TABLE 5.—*Nutrients and energy in food eaten and wasted in dietary study No. 365.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	19	22	2	280	5	6	....	73
Pork, lard, etc	22	40	4	460	2	3	....	35
Poultry	....	....	....	....	....	....	....	....
Fish, etc	8	8	2	111	4	1	2	33
Eggs	2	3	....	35	....	....	....	....
Butter	....	29	....	258	....	....	....	....
Cheese	5	6	1	77	....	....	....	....
Milk (evaporated cream)	15	18	23	412	....	....	....	....
Total animal food	71	126	32	1,533	11	10	2	141
Cereals	24	8	146	751	8	3	47	247
Sugars and starches	....	....	140	560	....	....	....	....
Vegetables	11	14	71	453	6	9	34	240
Fruits	1	1	39	169	....	....	2	8
Total vegetable food	36	23	396	1,933	14	12	83	495
Miscellaneous	14	21	63	495	4	6	13	121
Total food	121	170	491	3,961	29	28	98	757

This table shows that the diet furnished in food actually eaten 121 grams of protein, 170 grams of fat, 491 grams of carbohydrates, and

3,961 calories of energy per man per day. This consumption of nutrients and especially of energy is somewhat larger than that of the commonly accepted dietary standard for men at light to moderate muscular work, which calls for 112 grams of protein and 3,050 calories of energy per man per day. A definite classification of the persons in this group as regards amount of muscular activity could not be easily made. The amount of work done by the kitchen help was apparently more than by the attendants, though that performed by the individual attendants varied. It is very probable, however, that the food consumed was more than sufficient for their needs; indeed, as regards energy, it seems excessive. Undoubtedly this excess is due to the fact that from the abundant diet provided each person selected and ate freely of that which he liked and rejected that which did not suit his taste. This would tend to increase the total amount eaten, and as preferences were largely for desserts and side dishes that contained considerable proportions of carbohydrates and fat, and the menu was generally such that these tastes might be gratified, the excess of energy in the food consumption is easily accounted for.

The conditions in this study were such as would entail considerable waste. The amount rejected in the kitchen was apparently small, but that in the dining room was large, the total amount being sufficient to supply 29 grams of protein, 28 grams of fat, 98 grams of carbohydrates, and 757 calories of energy per man per day, or 19 per cent of the protein, 14 per cent of the fat, 17 per cent of the carbohydrates, and 16 per cent of the energy in the food served. Undoubtedly this large waste was in part due to the absence of attendants from their meals, as mentioned above. No allowance was made for this contingency in preparing the meals, the food being always provided for the maximum number. On the other hand, certain of the foods called for by the menu during the study were regularly provided, notwithstanding the fact that they were not relished and consequently were not eaten. For instance, chocolate pudding, though well made, was almost never eaten. There was also considerable rejection of staple articles of diet. While this was due in part to the fact that some of the attendants did not care for those particular foods, it was also in some measure due to the fact that the amounts supplied were in excess of normal needs.

It would of course be better economy to take account of such conditions as the above in planning the diet for such a group rather than to follow a prescribed course which it is known will result in waste of food, and, after the results of this study were known, the dietitian in charge of this dining room took advantage of the facts learned and made successful efforts to reduce the waste.

DIETARY STUDY NO. 371—SICK AND BEDRIDDEN MALE PATIENTS.

This study was made with 114 sick and bedridden chronic male patients in six wards, mainly for the purpose of determining the amount of food actually eaten and wasted, so that improvements might be made wherever desirable. The six wards were included in one study because the patients were all approximately of the same class, and were all supplied from the same kitchen, and so the foods could be weighed in large lots. The kitchen helpers, 6 in number, were also included in the study. Three of them were, in fact, patients, while the 3 who were not did not receive all their food in this department, and it was estimated that the difference between the average food consumption of these 3 and that of the patients was counterbalanced by the amount of food which they received from another department. No nurses nor attendants were supplied from this kitchen.

The study began with breakfast on Friday, December 12, 1902, after a day of preliminary observations, and continued 7 days, with 21 meals. The census for the study was obtained by taking the daily population of the wards, as these patients have no way of obtaining food except from this kitchen. The total number of meals taken was 2,385, equivalent to 1 man for 795 days.

The food was served from the "Allison kitchen," and was what is known as a "sick diet," but in addition to this a special diet was provided for a varying number of patients. Those who wished received toast and milk for breakfast and supper; a few received milk ad libitum; two patients received toast and milk each day for dinner; several patients received eggs at every meal, and one patient received whatever he ordered regardless of the regular menu. However, the food of this man was not weighed, and he was not included in the group studied. During the time of this study a small amount of extra food (oranges, etc.) was served besides the regular meals to two patients, but no separate account was taken of these extras as the quantities were so small.

It will be seen from the menu given below that the diet was planned to consist largely of soft, easily masticated foods, which it was believed would be easily and readily digested. The food was all cooked with the greatest possible care, very largely under the personal supervision of a dietitian. The dishes were garnished with lettuce, parsley, etc.; much attention was paid to flavoring and seasoning, and the food was all served as attractively as possible.

FRIDAY, DECEMBER 12, 1902.

Breakfast.—Oatmeal, salt mackerel, baked potatoes, toast,[a] bread, milk, scrambled eggs,[a] hot milk,[a] coffee.

Dinner.—Corn soup, boiled fish with egg sauce, boiled rice, sweet potatoes, stewed tomatoes, caramel ice cream, bread, toast,[a] milk, tea, crackers.

Supper.—Oyster stew, shredded wheat, apple sauce, bread, toast,[a] milk, baked potatoes,[a] tea.

SATURDAY, DECEMBER 13, 1902.

Breakfast.—Oatmeal, browned potatoes, beefsteak, milk, bread, toast,[a] baked potatoes,[a] eggs,[a] coffee.

Dinner.—Vegetable soup, roast beef with gravy, creamed mashed potatoes, macaroni and cheese, bread pudding with lemon sauce, boiled rice, eggs,[a] baked potatoes,[a] tea, crackers.

Supper.—Creamed chicken, baked potatoes,[a] stewed prunes, toast,[a] bread, eggs,[a] milk, tea.

SUNDAY, DECEMBER 14, 1902.

Breakfast.—Oatmeal, beefsteak, baked potatoes, toast,[a] rolls, milk, coffee.

Dinner.—Oyster soup, fricasseed chicken, mashed potatoes, celery, lemon jelly with custard sauce, toast,[a] baked potatoes,[a] milk, bread, jelly or preserves, butter, tea, crackers.

Supper.—Cold sliced boiled beef, apple sauce, bread, toast,[a] eggs.[a] milk, baked potatoes,[a] tea, cake.

MONDAY, DECEMBER 15, 1902.

Breakfast.—Wheat breakfast food, toast,[a] baked potatoes,[a] milk, eggs,[a] steak, browned potatoes, rolls, coffee.

Dinner.—Vegetable soup, beef stew, rice, stewed corn, junket with fruit, bread, sweet potatoes, baked potatoes,[a] tea, crackers.

Supper.—Scrambled eggs, toast,[a] baked potatoes,[a] baked apples, bread, milk, tea.

TUESDAY, DECEMBER 16, 1902.

Breakfast.—Liver and bacon, baked potatoes, toast, milk, coffee.

Dinner.—Tomato soup, roast mutton, mashed potatoes, rice, canned peas, chocolate blanc mange with custard sauce, milk, eggs,[a] bread, tea, crackers.

Supper.—Creamed dried beef, baked potatoes,[a] peach sauce, milk, eggs,[a] toast,[a] bread, tea.

WEDNESDAY, DECEMBER 17, 1902.

Breakfast.—Oatmeal, steak, browned potatoes, baked potatoes,[a] eggs,[a] milk, toast,[a] bread, coffee.

Dinner.—Potato soup, chicken stew, boiled rice, browned parsnips, baked potatoes,[a] floating island pudding, toast,[a] bread, milk, tea, crackers.

Supper.—Creamed oysters, milk, toast,[a] baked potatoes,[a] eggs,[a] apple sauce, tea.

THURSDAY, DECEMBER 18, 1902.

Breakfast.—Oatmeal, veal cutlets, eggs,[a] baked potatoes,[a] milk, toast,[a] bread, coffee.

Dinner.—Roast beef, baked potatoes,[a] sweet potatoes, turnips, eggs,[a] boiled rice, stewed corn, milk, bread, rice pudding, tea, crackers.

Supper.—Baked potatoes,[a] salmon, mush, eggs,[a] toast, bread, bananas, tea.

Bread served ad libitum. Beef tea served to a few sick patients at every meal. Butter served with breakfast and supper daily. Sugar and milk provided for tea and coffee.

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[a] Special diet.

Detailed data regarding the amount of food provided, eaten, and rejected during this study are given in Table 35 of the Appendix. These are summarized in the following table, showing the amounts of nutrients and energy per man per day in the food eaten and that rejected:

TABLE 6.—*Nutrients and energy in food eaten and wasted in dietary study No. 371.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	13	12	1	163	9	9		116
Poultry	3	3		39	1	1		13
Fish, etc	4	3		43	2	1		17
Eggs	8	6		85	1			4
Butter		17		151				
Milk	34	41	52	709	3	4	5	68
Total animal food	62	82	53	1,190	16	15	5	218
Cereals	20	7	118	614	13	2	77	378
Sugars and starches			55	220				
Vegetables	6	5	50	269	3	2	20	109
Fruits	1		27	112			3	12
Total vegetable food	27	12	250	1,215	16	4	100	499
Miscellaneous food	10	11	26	242	3	4	7	76
Total food	99	105	329	2,647	35	23	112	793

The food actually eaten furnished 99 grams of protein, 105 grams of fat, 329 grams of carbohydrates, and 2,647 calories of energy per man per day, amounts which are rather larger than was to be expected from the physical condition of the patients. Why this was the case it is difficult to say, but the recorded data show that a large amount of milk was used, both as a beverage and in the cooked foods. In fact, milk furnished fully 33 per cent of all the protein consumed. Milk is almost always an important article of food in the diet of the sick, and rightly so, since it affords an easy means of supplying the body with the necessary nutriment, and, moreover, is well liked by people in general and is well tolerated. These facts were evidently appreciated by the physicians in charge. It is quite probable that the patients regarded the milk as a drink rather than as a food, as such large amounts were taken. It is probably also true that the diet was much to the taste of the subjects, and this could hardly fail to be the case with those who had any appetite or capacity for appreciating their food. It is not altogether surprising, therefore, that the amounts of nutrients consumed by these patients were larger than might seem necessary.

On the other hand, it is not impossible that the digestive powers of these men were impaired to such an extent as to make the amounts of nutrients actually utilized by the body less than would be the case with people in robust health. If this be true, it would in part account for the seemingly large amounts of nutrients consumed. There is little doubt, however, that even if the proportions of nutrients digested were much less than normal, the amounts of energy were large as compared with the actual needs of the subjects, since they had almost no muscular exercise. In fact, many were bedridden, and life with some was undoubtedly at a very low ebb, the death rate in these wards being high.

The quantity of food rejected in this study was enough to supply 35 grams of protein, 23 grams of fat, 112 grams of carbohydrates, and 793 calories of energy per man per day, or 26 per cent of the protein and 23 per cent of the energy of the total food served. These proportions are large and are especially noticeable when some of the individual items are considered. For example, the amounts of beef, veal, and mutton rejected ranged from 24 to 52 per cent of the total provided. In fact there were comparatively few articles of which less than 20 per cent was rejected.

The food sent to these wards and not served is necessarily wasted for the reason that it is for the most part of such a character that it could not be prepared for serving again, but especially because coming from the sick wards there might be danger of spreading contagious diseases.

It would perhaps be impossible to govern the quantity of food wasted by such sick, infirm, and bedridden patients as made up the group included in this study. For many of them eating is no doubt a considerable effort, and the amounts which they consume vary with their condition from day to day. It is undoubtedly true that the margin of waste in sick wards in general must necessarily be larger than that for patients in better physical condition. Nevertheless, it was the opinion of the observer that the quantities noted were somewhat larger than necessary, owing to an oversupply of food. The correctness of this deduction is shown by the fact that after the study was completed the dietitian in charge made some improvements in this respect and curtailed the waste.

DIETARY STUDY NO. 366—MALE PATIENTS, MOSTLY INVALIDS.

This study was made with a group of 52 persons, mostly in wards Nos. 1 and 2 of the Toner building. The majority were sick, infirm, and bedridden patients. Several patients not particularly ill but given a light diet, some convalescents, and a few attendants and employees who were sick at the time were also included in the group.

The study began with breakfast, November 1, 1902, and continued for 7 days, with 21 meals. The total number of meals taken during the study was 1,086, equivalent to 1 man for 362 days.

The food for these wards differed in general from that for any other group studied, since it was in part the regular hospital diet, in part the regular attendants' diet, and in part a special diet.

The menu for these wards during this study is here given. This may be taken as typical of the diet regularly supplied to these wards, especially as regards the variety of articles of food served.

SATURDAY, NOVEMBER 1, 1902.

Breakfast.—Hominy, oatmeal, ham, fried eggs or boiled eggs, toast, milk, bread, coffee.

Dinner.—Bean soup, hash, creamed mashed potatoes, beets, sandwiches,[a] custard,[a] squash pie, toast, milk, bread, tea.

Supper.—Stewed oysters,[a] stewed beef, steak, scrambled eggs[a] and fried eggs,[a] apple sauce, custard,[a] bread, toast, milk, tea.

SUNDAY, NOVEMBER 2, 1902.

Breakfast.—Oatmeal, steak, scrambled eggs and boiled eggs, toast, rolls, milk, coffee.

Dinner.—Oyster soup, stewed chicken, baked sweet potatoes, stewed corn, boiled rice, milk, lemon jelly with custard sauce, rolls, toast, tea.

Supper.—Scrambled eggs and boiled eggs, milk, bread, toast, cake, bananas, tea.

MONDAY, NOVEMBER 3, 1902.

Breakfast.—Oatmeal, hominy, fried eggs and boiled eggs, bacon, milk, biscuit, toast, coffee.

Dinner.—Bean soup, steak,[a] roast beef, mashed turnips, boiled potatoes, boiled rice, bread pudding, toast, milk, bread, tea.

Supper.—Fried eggs, boiled eggs[a] and scrambled eggs,[a] cinnamon bread, stewed dried beef, grapes, milk, bread, toast, tea.

TUESDAY, NOVEMBER 4, 1902.

Breakfast.—Oatmeal, pork chops, baked potatoes, fried eggs,[a] boiled eggs[a] and scrambled eggs,[a] corn bread, rolls, milk, toast, coffee.

Dinner.—Chicken,[a] roast beef, boiled squash, boiled rice,[a] mashed potatoes, rice pudding, milk, bread, toast, tea.

Supper.—Cold roast beef, eggs on toast,[a] fried eggs and boiled eggs, baked apples, milk, bread, toast, tea.

WEDNESDAY, NOVEMBER 5, 1902.

Breakfast.—Oatmeal, steak, potatoes, fried eggs and boiled eggs,[a] bread, toast, milk, coffee.

Dinner.—Chicken,[a] roast veal, boiled rice, baked sweet potatoes, canned peas, milk, bread, toast, tea.

Supper.—Hash, oyster stew,[a] fried eggs[a] and boiled eggs,[a] baked apples, gingerbread, toast, bread, milk, tea.

THURSDAY, NOVEMBER 6, 1902.

Breakfast.—Oatmeal,[a] mush, steak, baked potatoes, scrambled eggs,[a] fried eggs[a] and boiled eggs,[a] biscuit, toast, milk, coffee.

Dinner.—Stewed chicken, steak,[a] stewed corn, rice, beets, lemon jelly, toast, bread, milk, tea.

Supper.—Boiled eggs and scrambled eggs, custard,[a] stewed prunes, milk, bread, toast, tea.

FRIDAY, NOVEMBER 7, 1902.

Breakfast.—Oatmeal, boiled potatoes, salt mackerel, fried eggs,[a] boiled eggs[a] and scrambled eggs,[a] rolls, milk, toast, coffee.

Dinner.—Clam soup, baked cod,[a] steak,[a] oyster stew,[a] stewed tomatoes, boiled potatoes, creamed mashed potatoes, boiled cod, boiled rice, custard, bread, milk, toast, tea.

Supper.—Scalloped oysters, poached eggs on toast,[a] boiled eggs,[a] fried and scrambled eggs,[a] steak,[a] custard,[a] toast, bread, milk, grapes, tea.

Butter served with every meal. Sugar and milk provided as usual.

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[a] Special or extra diet.

The statistics regarding the quantities of food provided, eaten, rejected, etc., are given in Table 35 of the Appendix. The data regarding the quantities of nutrients and energy per man per day in the food eaten and rejected are summarized in Table 7. Considerable difficulty was experienced in this study in separating the different kinds of food rejected so as to get the weights of each. Frequently allowances and estimates had to be made, and though in some cases it was almost impossible to make satisfactory estimates, this was done as carefully as possible, and the data as recorded are believed to be not far from correct.

TABLE 7.—*Nutrients and energy in food eaten and wasted in dietary study No. 366.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	16	16	....	206	4	4	....	51
Pork, lard, etc	4	7	1	82	2	2	1	30
Poultry	2	2	....	26	2	2	....	26
Fish, etc	3	2	1	31	1	1	....	13
Eggs	10	12	....	147	1	1	....	13
Butter	....	26	....	231	....	7	....	62
Milk (evaporated cream)	26	31	39	536	2	3	3	47
Total animal food	61	96	41	1,262	12	20	4	242
Cereals	21	5	126	633	15	3	86	431
Sugars and starches	....	....	....	....	....	....	....	....
Vegetables	4	3	28	154	2	1	15	77
Fruits	1	....	15	64	....	....	5	20
Total vegetable food	26	8	169	851	17	4	106	528
Miscellaneous food	5	5	17	133	2	2	5	45
Total food	92	109	227	2,246	31	26	115	815

The quantities of nutrients and energy per man per day in the food eaten during this study were larger than was to be expected, being very nearly the same as in study No. 371, which was also made with patients more or less infirm. From a comparison of the figures in the table above with those in Table 6 it would appear that the quantity of carbohydrates, and consequently of energy also, was considerably smaller in the present study than in No. 371, but unfortunately the amount of sugar consumed was not learned. The observer was able to ascertain, however, that it was not large, but was probably as much as would make the total energy of the food consumed about the same as that in study No. 371, and certainly fully sufficient for the needs of the patients.

In this study, as in No. 371, the protein furnished by milk was large, being as much as the total from all vegetable foods. Eggs also formed a noticeable part of the diet, and properly, because though not always a cheap food, they are of special value in the diet of the sick. The diet seemed on the whole to be very well suited to the needs of the patients, as there was seldom any complaint, and the physician in charge considered it very satisfactory.

The total amount of food rejected in this study was large, as in study No. 371 with patients of a similar class. From the statistics in Table 35 of the Appendix it will be observed that very large amounts of some of the individual articles were rejected. While this may have been due to some extent to the varying appetite of the patients, in the case of the cereals and vegetables it was undoubtedly due in part to an excess in the amounts served. Canned corn, peas, tomatoes, and squash, which were necessarily used at this season of the year, were apparently not much relished, and the amounts rejected were large, as was also the case with hash, which though well made was not generally liked.

In this study bread, toast, and, in one instance, grapes were the only foods returned to the kitchen which were served again. In wards of this nature apparently any reduction of the amounts rejected by the patients must be made by closely observing the amounts consumed and serving accordingly, for food once served is necessarily wasted if not eaten. It would seem that in these wards, where the time allowed for eating can be made as long as needed, smaller individual servings might be advantageous, the privilege of a second helping being allowed if more food is desired.

DIETARY STUDY NO. 367—MALE PATIENTS, NONWORKERS.

This study was made with about 103 male patients who were quiet, orderly, and in fairly good physical condition. Like the subjects of study No. 364, they were nonworkers. Meals were eaten in the large "Oaks dining room," which is situated near the kitchen where the food was cooked, so it reached the table fairly hot.

The study began with breakfast, November 12, 1902, and continued for 7 days, with 21 consecutive meals. The total number of meals taken was 2,157, or equivalent to 1 man for 719 days.

This study and No. 368, although with different classes of patients, were carried on simultaneously, as the food for both was supplied from the "Toner general kitchen," and it was possible to make the weighings for both at the same time.

The diet was the same as that served to able-bodied patients throughout the institution, the articles all coming from the same general storeroom and being practically of the same grade and quality.

The menu, which with a few unimportant exceptions was the same for both studies, is given here. This menu does not include "special diet" articles, small amounts of which were served.

WEDNESDAY, NOVEMBER 12, 1902.

Breakfast.—Bread, butter, coffee, oatmeal, hash.

Dinner.—Cabbage, boiled sweet potatoes, corned beef boiled, bread, tea.

Supper.—Canned rhubarb stewed, gingerbread, bread, butter, tea.

THURSDAY, NOVEMBER 13, 1902.

Breakfast.—Stewed prunes, mush, coffee, bread, hot rolls, butter.

Dinner.—Kidney beans boiled, bread,[a] beef stew, bean soup, crackers.

Supper.—Bread, butter, tea, beans baked.

FRIDAY, NOVEMBER 14, 1902.

Breakfast.—Bread, hot biscuit, steamed potatoes, salt mackerel boiled, butter, coffee.

Dinner.—Baked fresh cod, cucumber pickles, fruit pudding steamed, sweet potatoes, macaroni and tomatoes boiled, bread,[a] butter, coffee.

Supper.—Bread, butter, cheese, tea, stewed peaches.

SATURDAY, NOVEMBER 15, 1902.

Breakfast.—Bread, butter, coffee, hominy, beefsteak.

Dinner.—Vegetable soup, boiled cabbage, jowl or pig's head boiled, steamed potatoes, bread.

Supper.—Stewed prunes,[b] Graham bread, butter, tea.

SUNDAY, NOVEMBER 16, 1902.

Breakfast.—Wheat breakfast food, bread, hot biscuit, butter, baked beans, coffee.

Dinner.—Roast pork, steamed beets, baked sweet potatoes, bread,[a] butter, apple pie, coffee.

Supper.—Bread, butter, apple sauce, plain cake, tea.

MONDAY, NOVEMBER 17, 1902.

Breakfast.—Hot rolls, steamed sweet potatoes, hominy, fried sausage, butter, coffee.

Dinner.—Pea soup, sweet potatoes, boiled pork shoulder, cold slaw, bread,[a] crackers.

Supper.—Currant jelly, bread, cinnamon bread, apple butter, butter, tea.

TUESDAY, NOVEMBER 18, 1902.

Breakfast.—Hot rolls, butter, wheat breakfast food, liver and bacon, coffee.

Dinner.—Bread, beef stew, vegetable soup, squash pie, potatoes, stewed peas, crackers.

Supper.—Bread, butter, apple butter, finger rolls, tea.

Sugar and milk provided for beverages. This menu does not include "special diet" articles.

The usual data regarding the amounts of food provided, eaten, rejected, and returned are found in Table 35 of the Appendix. The computations of the quantities of nutrients and energy per man per day in the food eaten and that rejected are summarized in the table here given.

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[a] For study No. 368, biscuit.

[b] Study No. 368, apple sauce.

TABLE 8.—*Nutrients and energy in food eaten and wasted in dietary study No. 367.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	5	5	....	65	2	2	....	26
Pork, lard, etc	8	18	....	192	2	3	....	35
Poultry	....	....	....	....	....	....	....	....
Fish	2	1	....	17	2	2	....	25
Eggs	2	2	....	26	....	....	....	....
Butter	1	29	....	262	....	4	....	36
Cheese	1	1	....	13	....	....	....	....
Milk (evaporated cream)	3	3	4	54	....	....	....	....
Total animal food	22	59	4	629	6	11	....	122
Cereals	29	5	176	864	8	2	49	246
Sugar and starches	....	....	94	376	....	....	....	....
Vegetables	9	5	53	293	3	1	15	81
Fruits	1	....	31	128	....	....	21	84
Total vegetable food	39	10	354	1,661	11	3	85	411
Miscellaneous food	11	13	27	268	3	3	5	58
Total food	72	82	385	2,558	20	17	90	591

Before this study began it was the impression of both the dietitian and the physician in charge that the amount of food eaten by these patients was less than might be expected, though no definite reason was assigned for this belief other than the fact that they were quiet, nonworkers. The opinion proved to be justified. The quantities of nutrients and energy, 72 grams of protein and 2,558 calories per man per day, in the food eaten were smaller than those observed in a previous study (Table 4) with a somewhat similar class of patients—though in that case some workers were included—and smaller as regards protein than the commonly accepted American dietary standard for men in health with little or no muscular exercise, namely, 90 grams of protein and 2,450 calories of energy. It might be urged that the amounts of food eaten were smaller than the patients required, but this is much to be doubted, since the amounts provided were generous and the patients were served more than they cared to eat. It may be that though well prepared the food was not suited to their tastes. Considering the nature and amount of the food which they rejected, however, it seems reasonably certain that they ate as much as they would have cared for under any circumstances, and that this was abundantly sufficient to satisfy their bodily needs, since their activity was slight.

The food rejected in this study was enough to supply 20 grams of protein, 17 grams of fat, 90 grams of carbohydrates, and 591 calories of energy per man per day, or 22 per cent of the protein, 17 per cent of the fat, 19 per cent of the carbohydrates, and 19 per cent of the energy of the total food served. It is noticeable that the percentage of protein rejected was larger than that of the carbohydrates, a condition which is not often noted in dietary studies, though observed also in others here reported. These percentages of rejected food were higher than is believed necessary in a dining room of this kind.

The amounts of some of the individual articles rejected are worthy of note. Data of this character are given in Table 35 of the Appendix. It will be seen that the amount of meats rejected was large, as was also that of the cereal breakfast foods. This would seem to indicate either that the amounts served were too large, or that the kinds were not relished, or both. In the case of the breakfast foods, it seemed certain that too much was provided.

The rejection of cucumber pickles was undoubtedly due to an oversupply. This article is ordinarily and properly supplied merely as a relish and not as a food, and the quantity eaten is naturally not large.

As a general thing, the quantity of vegetables eaten, other than potatoes, is very apt to vary widely from day to day, as individuals differ markedly in their preference for such foods. Therefore, in studies of this kind the amount of vegetables rejected may be normally quite large, since the aim is necessarily to supply always enough for all. This would account, in part at least, for the large amount of vegetables rejected in this study.

The amount of butter rejected was larger than might have been expected, but it was not necessarily a waste, since it might have been used for cooking purposes.

The amount of apple butter rejected is believed to be due to the fact that it was not especially palatable. The amounts of apple sauce, peach sauce, and stewed prunes rejected were also large. Such fruit products hold an important place in the dietetics of this institution, being served with supper very frequently. They are relatively inexpensive, and though in themselves they have comparatively little nutritive value aside from the sugar added in preparing them, their flavor is generally relished, and they tend to increase the consumption of bread, a food which is both cheap and nutritious. Hence, even though the quantities rejected be large, their use should not be discouraged. The apparent waste could be diminished by reducing the amount served to more nearly what is likely to be eaten and by returning what is not served to the kitchen for use at another time.

It was in this study, which was the fourth made, that improvements due to the investigation began to be noticeable, especially as regards the utilization of the excess of food sent from the kitchen to the dining room but not served. Ordinarily, though in just as good condition as when it left the kitchen, it was added to that left upon the plates by the patients and sent to the garbage can. An attempt was made to have such material returned to the kitchen and to find ways of using it. About 9 per cent of the bread provided was returned in this study and used for bread pudding and in other ways; "left-over" potatoes were also carefully saved and used for hash and in other ways, as would be the case in an ordinary household. The physician in charge of the department cooperated most heartily with the dietitian in charge of the kitchen and the observer in trying to have unused food returned to the kitchen and utilized. From the standpoint of economy the amounts saved were of some importance, and at the same time the character of the diet did not suffer.

DIETARY STUDY NO. 368—MALE PATIENTS, ACUTE CASES.

This study was conducted with 26 male patients, mostly acute cases, confined entirely to their ward and constantly under considerable nervous and mental strain.

The study began with breakfast, November 12, 1902, and continued 7 days, with 21 meals. The total number of meals taken was 546, equivalent to 1 man for 182 days. The menu was practically the same as in dietary study No. 367.

The data concerning the total amounts of food provided, returned, eaten, and rejected are shown in Table 35 of the Appendix. The quantities of nutrients and energy per man per day in the food consumed and rejected are summarized in the following table:

TABLE 9.—*Nutrients and energy in food eaten and wasted in dietary study No. 368.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	4	4	....	52	4	3	....	43
Pork, lard, etc	7	16	....	170	2	5	....	53
Fish, etc	3	2	....	30	3	2	....	30
Butter	1	31	....	280	....	4	....	35
Cheese	1	2	....	22	....	....	....	....
Milk (evaporated cream)	6	7	9	122	....	....	....	....
Total animal food	22	62	9	676	9	14	....	161
Cereals	33	6	201	989	10	2	66	322
Sugars and starches	....	....	59	236	....	....	....	....
Vegetables	9	5	48	273	4	1	23	117
Fruits	1	....	35	144	1	....	38	156
Total vegetable food	43	11	343	1,642	15	3	127	595
Miscellaneous food	11	13	26	263	2	3	2	42
Total food	76	86	378	2,581	26	20	129	798

From the table above it will be seen that the food eaten furnished 76 grams of protein, 86 grams of fat, 378 grams of carbohydrates, and 2,581 calories of energy per man per day, or practically the same amounts as were found in the preceding study. While these quantities are somewhat smaller than might have been anticipated, there is no doubt that the patients had all they cared to eat. The amounts served to them were generous and considerable food was left uneaten, 25 per cent of the protein and 24 per cent of the energy of the food served being rejected. From the statistics given in Table 35 of the

Appendix it will be observed that this was not confined to any one kind of food, but that a large proportion of different foods was rejected. It seems quite probable from these data that the amounts provided were too large for the appetites, if not the needs, of the patients. Had they eaten all the food served to them the amounts of nutrients per man per day would have been 102 grams of protein, 106 grams of fat, and 507 grams of carbohydrates, with 3,379 calories of energy, which, as regards energy, would be sufficient for the average man at ordinary muscular work, and perhaps nearly sufficient as regards protein also.

DIETARY STUDY NO. 369—ATTENDANTS, HOUSE GIRLS, ETC.

This and the following study, No. 370, were carried on simultaneously, with attendants, house girls, waiters, etc., one group having their meals in the dining room of the Toner building and the other in that of the Oaks building. All three meals, breakfast, dinner, and supper, were served twice each day in both dining rooms, so that for each article served four weighings were necessary. The studies began on Monday, November 24, 1902, and ended December 1. They covered 7 days, with 21 meals, as usual, since no account was taken of the food on November 27 (Thanksgiving day), when the regular menu was not served.

Study No. 369 comprised 14 persons, 10 males and 4 females. The total number of meals taken was equivalent to 280 meals per man, or equivalent to 1 man 93 days. In order to compute the equivalent number of meals per man from the total number eaten, it was assumed that the average food consumption per woman was 0.8 as much as that per man; thus 21 meals per woman would be 16.8 meals per man.

The menu served during these two studies is given herewith. This was supposed to be the same as that for attendants throughout the institution.

MONDAY, NOVEMBER 24, 1902.

Breakfast.—Prunes,[a] oatmeal, sausage, fried hominy, Graham rolls, coffee.

Dinner.—Pea soup, pork shoulder, creamed mashed potatoes, boiled rice, mashed turnips, baked custard, bread, crackers, tea.

Supper.—Cold roast beef, fried potatoes, stewed prunes, bread, tea.

TUESDAY, NOVEMBER 25, 1902.

Breakfast.—Oatmeal, liver and bacon, sweet potatoes, rolls, coffee.

Dinner.—Roast beef, baked sweet potatoes, boiled cabbage, tomato soup, rhubarb pie, bread, tea, crackers.

Supper.—Cold shoulder, fried potatoes, apple sauce, bread, tea.

WEDNESDAY, NOVEMBER 26, 1902.

Breakfast.—Oatmeal, fried ham, baked potatoes, hot rolls, coffee.

Dinner.—Bean soup, roast or corned beef, mashed potatoes, mashed turnips, cabbage slaw, rice pudding, bread, tea, crackers.

Supper.—Cold corned beef, baked apples, bread, tea.

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[a] Served only to subjects of study No. 370.

FRIDAY, NOVEMBER 28, 1902.

Breakfast.—Oatmeal, salt mackerel, baked potatoes, baked beans, biscuit, coffee.

Dinner.—Oyster soup, roast beef, baked cod, boiled potatoes, boiled beets, boiled rice, tea.

Supper.—Deviled eggs, cheese, celery, peach sauce, bread, soda biscuit, tea.

SATURDAY, NOVEMBER 29, 1902.

Breakfast.—Oatmeal, beefsteak, baked potatoes, bread, coffee.

Dinner.—Vegetable soup, boiled beef, bread dressing, sweet potatoes, boiled squash, cabbage slaw, blanc mange pudding with sauce, bread, crackers, coffee.

Supper.—Stewed beef, prune sauce, Graham bread, tea.

SUNDAY, NOVEMBER 30, 1902.

Breakfast.—Oatmeal, fried ham, baked beans, baked sweet potatoes, biscuit, coffee.

Dinner.—Roast beef, mashed potatoes, turnips, cranberry sauce, mince pie, bread, tea.

Supper.—Peach sauce, cake, bread, tea.

MONDAY, DECEMBER 1, 1902.

Breakfast.—Oatmeal, sausage, fried hominy, hot rolls, coffee.

Dinner.—Pea soup, browned potatoes, boiled shoulder, boiled cabbage, cranberry sauce, bread pudding with lemon sauce, bread, tea, crackers.

Supper.—Dried beef, mashed browned potatoes, cinnamon bread, apple sauce, bread, tea.

Butter served as desired. Bread ad libitum. Sugar and milk provided.

The detailed statistics concerning the food in this study, No. 369, are given in Table 35 of the Appendix. The following table summarizes the results as computed to show the quantities of nutrients and energy per man per day in the food eaten and in that rejected:

TABLE 10.—*Nutrients and energy in food eaten and wasted in dietary study No. 369.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	22	25	1	315	23	27	1	336
Pork	12	24		262	6	10		113
Fish	3	2		30	3	3		39
Eggs	1	1		12				
Butter	1	48		431		8		71
Cheese	2	3		35				
Milk	5	6	8	105				
Total animal food	46	109	9	1,190	32	48	1	559
Cereals	29	5	166	825	20	5	113	577
Sugars and starches			33	132				
Vegetables	13	10	85	481	14	9	75	436
Fruits			33	132	1		38	156
Total vegetable food	42	15	317	1,570	35	14	226	1,169
Miscellaneous food	12	17	44	375	5	5	18	136
Total food	100	141	370	3,135	72	67	245	1,861

The average amount of muscular work performed by the persons in this group might perhaps be considered equivalent to that of a man engaged at light to moderate muscular work. The commonly accepted dietary standard for this calls for 112 grams of protein and 3,050 calories of energy per day. The results of this study were a little lower than this standard as regards protein, and slightly above as regards energy. Apparently, therefore, the food consumption of these persons was sufficient for their bodily needs. Another indication that such was the case is found in the fact that the food provided was greatly in excess of what was eaten, which would naturally indicate an oversupply rather than the opposite, when as was the case the diet was reasonably varied and the foods were well cooked.

The amount of food rejected in this study was very large, and contained about 42 per cent of the protein and 37 per cent of the energy of the total food served. In addition to this a considerable proportion of some of the articles brought to the dining room was returned to the kitchen. That the food provided was excessive is more plainly shown by the fact that had all the food served been eaten there would have been a consumption of 172 grams of protein, 208 grams of fat, and 615 grams of carbohydrates per man per day.

DIETARY STUDY NO. 370—ATTENDANTS, HOUSE GIRLS, ETC.

The group included in this study comprised 22 males and 6 females (house girls, attendants, waiters, etc.). As previously noted, the study was carried on at the same time and under the same conditions as No. 369. An accurate account of the number of meals eaten was kept as usual, but, unfortunately, such data for the first 3 days of the study were lost. However, it is believed that the number did not vary greatly from day to day, and that no considerable error is introduced by assuming that the average attendance at each meal of the seven days was the same as during the last four days. Making this assumption and counting the food eaten by 1 woman as equal to 0.8 that of 1 man, the total number of meals taken was equivalent to 563 for a man, or 1 man for 188 days.

The menu served was the same as in dietary No. 369.

The food statistics in detail are found in Table 35 of the Appendix. The quantities of nutrients and energy per man per day in the food eaten and that rejected are summarized in the following table:

Table 11.—*Nutrients and energy in food eaten and wasted in dietary study No. 370.*

[Quantities per man per day.]

Food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	26	27	....	344	12	12	1	159
Pork, lard, etc	18	34	1	379	4	7	....	78
Fish, etc	3	2	....	29	3	3	....	39
Eggs	3	3	....	39	1	1	....	13
Butter	1	80	....	716	....	....	....	....
Cheese	1	2	....	22	....	....	....	....
Milk	10	12	15	207	....	....	....	....
Evaporated cream	2	2	2	34	....	....	....	....
Total animal food	64	162	18	1,770	20	23	1	289
Cereals	41	11	244	1,238	11	2	63	314
Sugars and starches	....	....	139	556	....	....	....	....
Vegetables	14	10	83	477	10	6	51	297
Fruits	1	....	45	184	1	....	37	152
Total vegetable food	56	21	511	2,455	22	8	151	763
Miscellaneous food	11	15	49	373	3	5	5	76
Total food	131	198	578	4,598	15	36	157	1,128

The average food consumption in this dietary study, 131 grams of protein and 4,598 calories of energy per man per day, is much larger than that of the persons with similar occupation included in the preceding study; in fact it is slightly higher in protein and decidedly higher in energy than the commonly accepted American standard for a man at moderately active muscular work, i. e., 125 grams of protein and 3,400 calories of energy. Apparently these persons had large appetites, or they ate more than they actually needed. They certainly ate much more than ordinary people doing equivalent work.

The excess of energy in the diet is largely due to the unusual amount of sugar eaten. In no other study made in this institution, with the exception of No. 365 with a group of persons similar to those in the present study, was so much sugar consumed. In No. 369, the preceding study with a similar group, the consumption of sugar was no more than is commonly found.

The food rejected in this study contained 26 per cent of the protein and 20 per cent of the energy in the total food served. While this was larger than seemed necessary, it was very much smaller than in the preceding study. The difference in the amounts rejected is accounted for by the difference in amounts eaten, for the total amount of food served per man per day was 3 per cent larger in study No. 370 than in No. 369. From a comparison of the amounts wasted in the two studies it is apparent that the food provided in study No. 369 could have been reduced at least 25 per cent and still leave an excess over the amount actually eaten.

DIETARY STUDY NO. 372—MALE PATIENTS, LARGELY NEGROES, CRIMINAL INSANE.

The patients in this study occupied four wards in the Howard Hall building, which is the criminal department of the institution. The population of this department is composed largely of criminal insane sent from prisons and reformatories, though it includes also those who were committed there directly because of criminal acts due to their demented condition. The patients in these four wards ate in the same dining room. About 65 were included in the study, all males, and all but 16 were negroes. They were in good physical health, and many appeared to be robust. Among this group were 19 who were classed as workers, and a few of them did considerable work, though for short periods only. It seems fair to consider therefore that they did not perform any greater amount of muscular work than men ordinarily engaged at light muscular work. All the patients included in the group took some daily exercise walking, but the amount was probably comparatively small.

During the study 9 attendants also ate in this dining room. Their food was for the most part served separately, though some of it was prepared with that of the patients. These men have been included in this study for the reason that no separate classification could be easily made of them, and it seemed practically impossible to keep their food entirely separate.

The study began with breakfast, February 2, 1903, and continued 7 days, with 21 meals. The total number of meals taken by patients and attendants was 1,556, equivalent to 1 man for 519 days.

During the week of this study the following menu was served:

MONDAY, FEBRUARY 2, 1903.

Breakfast.—Oatmeal,[a] fried sausage, boiled hominy, Graham biscuit, butter, coffee.

Dinner.—Bean soup, boiled shoulder, steamed potatoes, boiled cabbage,[a] boiled rice, apple dumplings,[a] soda crackers, bread.

Supper.—Boiled beef [b] and pigs feet,[a] rhubarb sauce, doughnuts, bread, butter, tea.

TUESDAY, FEBRUARY 3, 1903.

Breakfast.—Wheat breakfast food, apple sauce, beef stew,[b] pork chops and gravy,[a] baked potatoes,[ab] hot rolls, coffee, butter.

Dinner.—Stewed peas,[a] pork stew, boiled Lima beans, bread pudding, steamed browned potatoes,[a] roast pork with gravy,[a] bread, butter, coffee.

Supper.—Apple sauce, smoked herring,[a] shoulders,[b] fritters,[a] rolls, butter, tea.

WEDNESDAY, FEBRUARY 4, 1903.

Breakfast.—Oatmeal, liver and bacon,[a] stewed potatoes,[ab] beef stew,[b] rolls, butter, coffee.

Dinner.—Bean soup, corned beef, steamed potatoes, boiled cabbage, tapioca pudding,[a] crackers, bread.

Supper.—Rhubarb sauce, fried potatoes,[a] cold corned beef,[b] head-cheese,[a] ginger cake, bread, butter, tea.

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[a] For attendants.

[b] For working patients.

THURSDAY, FEBRUARY 5, 1903.

Breakfast.—Liver and bacon, corn-meal mush, beefsteak,[a] baked potatoes,[a] biscuit, butter, coffee.

Dinner.—Tomato soup, beef potpie, creamed mashed potatoes,[a] mashed turnips,[a] succotash, bread.

Supper.—Baked beans, beef potpie,[b] corned beef,[a] soda biscuit, bread, apple sauce,[a] butter, tea.

FRIDAY, FEBRUARY 6, 1903.

Breakfast.—Boiled salt cod, steamed potatoes, fried mush,[a] oatmeal,[a] fried salt mackerel,[a] bread, butter, coffee.

Dinner.—Bean soup, baked cod, cucumber pickles, boiled rice, boiled macaroni, steamed pudding, tomato soup,[a] crackers, steamed browned potatoes,[a] boiled beef,[a] rice pudding,[a] bread.

Supper.—Tomato preserves,[a] pork shoulder,[b] codfish cakes,[a] soda biscuit,[a] apple sauce, bread, butter, tea.

SATURDAY, FEBRUARY 7, 1903.

Breakfast.—Oatmeal,[a] hominy, beefsteak and gravy, corn bread,[a] baked potatoes, bread.

Dinner.—Vegetable soup, pork heads, boiled turnips, browned potatoes,[a] stewed potatoes, stewed peas,[a] roast beef and gravy,[a] crackers, bread.

Supper.—Boiled beef,[b] rhubarb sauce, bread, roast pork,[a] prune sauce,[a] butter, tea.

SUNDAY, FEBRUARY 8, 1903.

Breakfast.—Baked beans, wheat breakfast food,[a] fried ham,[a,b] fried potatoes,[a] rolls, butter, coffee.

Dinner.—Vegetable soup,[a] roast pork with gravy, cucumber pickles, steamed potatoes, stewed tomatoes, apple pie, creamed mashed potatoes,[a] cornstarch pudding,[a] bread, coffee.

Supper.—Stewed prunes, plain cake, bread, baked beans,[a] jelly cake,[a] celery salad.[a]

Attendants received 2 quarts milk with breakfast and supper, 1 quart with dinner. Sugar and milk are added in the kitchen to tea and coffee supplied to patients. Butter supplied with each meal to attendants. Bread supplied ad libitum.

The data regarding the kinds and amounts of food provided, returned to the kitchen, eaten, and rejected are given in detail for this study in Table 35 of the Appendix. The following table summarizes the results:

TABLE 12.—*Nutrients and energy in food eaten and wasted in dietary study No. 372.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	14	14		181	2	2		26
Pork	19	31		352	1	2		22
Fish	4			16	4	1		25
Butter		20		178		11		97
Milk	1	2	2	29				
Total animal food	38	67	2	756	7	16		170

[a] For attendants.

[b] For working patients.

TABLE 12.—*Nutrients and energy in food eaten and wasted in dietary study No. 372*—Con.

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Cereals	35	12	216	1,111	14	3	84	419
Sugars and starches			24	96				
Vegetables	10	4	54	291	4	1	23	117
Fruits			23	92			4	16
Total vegetable food	45	16	317	1,590	18	4	111	552
Miscellaneous food	12	15	29	298	2	2	1	30
Total food	95	98	348	2,644	27	22	112	752

The data in the table show that the amounts of nutrients and energy in the food actually eaten, 95 grams of protein and 2,644 calories of energy, were not particularly different from those found in study No. 364, being a trifle higher in protein and lower in energy. This is about what would be expected, since the subjects in both studies had about the same amount of muscular exercise.

In this study about 22 per cent of the total protein and energy of the food served was rejected. The amount of animal food other than fish rejected was small, but fish was evidently not relished by these patients as a considerable proportion of that served was not eaten. Most of the desserts served were eaten, though it should be mentioned that only the attendants received tapioca, rice, and cornstarch puddings. Other articles on the menu that were prepared expressly for the attendants were smoked herring, pork chops, head-cheese, boiled beef, fritters, corn bread, fried potatoes, celery salad, tomato preserves, apple dumplings, and codfish cakes. Any portions of these articles left after the attendants were served were, however, saved for the working patients. The amount of cereal foods rejected was large. The wheat breakfast foods, and in fact all the breakfast foods, were evidently not relished. The amount of bread rejected, largely crusts, was greater than was to be expected. The bread served in this study was of good quality, and there was apparently no reason why the crusts should not be eaten. The patients in general preferred bread not over 24 hours old.

The amount of butter rejected was much larger in this department than was usually the case. It was noticed that butter was served at some meals where the menu did not provide for it. It seems probable that the amount supplied was in excess of what was needed. A large part of the waste of food in this study may probably be accounted for by the fact that the portions for each patient were placed on his plate before he sat down to the table, and so any excess was necessarily wasted. This method of serving, which is generally wasteful, was followed in only a few wards, and may not have been necessary here, though the attendant in charge gave it as his opinion that the patients were not intelligent enough to be supplied in the customary way.

The attendant in charge also stated that no attempt was made as a rule to return to the kitchen any foods not served except steamed potatoes, bread, and meat. During the time of this study no food was returned (Table 35 of the Appendix), hence the food provided and that served were the same, and of course equal to the sum of the food rejected and eaten.

Although the proportion of food rejected was somewhat larger than might seem necessary, even with the method of serving followed, yet the amounts sent to this dining room are probably as a rule not very much larger than they should be, to allow for the varying appetites of the men. The attendant in charge believed that though amply sufficient they were none too great.

DIETARY STUDY NO. 373—MALE PATIENTS, CRIMINAL INSANE.

This study was made with about 90 patients and 10 attendants, all white males, fed in Howard Hall dining room No. 2, the food being supplied from the general kitchen. The patients were insane criminals, as in the preceding study. A few of them did a little work in the wards and dining room, but the larger number had no regular occupation. They all appeared to be in good physical health and well nourished. It was the opinion of the persons in charge of the dining room that the men were very hearty eaters.

The study began with breakfast, February 10, 1903, and continued 7 days. The total number of meals taken was 2,080, equivalent to 1 man for 693 days.

The menu served varied little from that of the preceding study.

As was the case in the preceding study, some of the foods were provided primarily for the attendants, namely, fried chipped beef, Bologna sausage, mutton chops and roast, boiled pork, head-cheese, corn bread, cucumber pickles, stewed peas, fried and boiled potatoes, baked sweet potatoes, preserved tomatoes, baked apples, cornstarch pudding, and rice pudding. However, any portions left after the attendants were served were given to the patients.

The data regarding the kinds and amounts of food provided, etc., are given in Table 35 of the Appendix. In the following table are summarized the figures showing the quantities of nutrients and energy per man per day in the food eaten and rejected:

TABLE 13.—*Nutrients and energy in food eaten and wasted in dietary study No. 373.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	19	19	....	245	3	3	....	39
Pork	6	12	....	131	1	1	....	13
Fish	5	5	....	64	1	1	....	13
Butter	....	21	....	187	....	5	....	44
Milk	2	2	3	38	....	....	....	....
Total animal food	32	59	3	665	5	10	....	109
Cereals	38	13	240	1,228	8	1	48	233
Sugar and starches	....	....	12	48	....	....	....	....
Vegetables	11	5	52	296	2	1	8	49
Fruits	....	....	36	144	....	....	4	16
Total vegetable food	49	18	340	1,716	10	2	60	298
Miscellaneous food	13	16	26	299	2	2	3	38
Total food	91	93	369	2,680	17	14	63	445

The average quantities of protein, 94 grams, and energy, 2,680 calories, per man per day in the food eaten by this group were almost identical with those noted in the preceding study and practically conform to the commonly accepted standard for the ordinary man in health with little muscular activity. It is interesting to note that in this study the proportion of total protein furnished by cereal foods is larger than has been commonly found in dietary studies of American families.

The quantity of nutrients and energy rejected was nearly 40 per cent less than that in the preceding study. Considering the proportions of the individual articles rejected (Table 35 of the Appendix), it will be observed that the largest waste was with the cereal breakfast foods and similar articles. This may have been due to an excessive supply. In the case of most of the other materials the amount rejected was perhaps hardly more than might be expected under the circumstances, though 18 per cent for the bread is large for bread of such good quality.

During this study the observer was informed that the quantities of rejected material were very small as compared with what had previously been brought away. Doubtless more care was observed in serving than was formerly the case, yet no complaints were heard that the quantities provided were not sufficient. The moral influence of an investigation like this is by no means inconsiderable, and it happens very naturally that more care is taken by persons who feel that their work is under observation. It was the opinion of the superintendent that this fact alone had been responsible for much improvement in this respect in this and other departments of the institution.

DIETARY STUDY NO. 374—MALE PATIENTS, NEGROES.

This study was made with about 170 male patients, occupying West Lodge, in the Howard Hall department, all of whom were insane negroes other than criminals. From 15 to 30 were in restraint a large part of the time and many were very violent at certain periods. Most of them were in good physical health and were considered very hearty eaters, being noticeably fond of meat. From 70 to 80 of these patients did a fairly large amount of work, many of them being employed out of doors all day, digging tunnels, improving driveways, etc., and handling pick and shovel for 7 or 8 hours a day.

Most of the patients in this group had their meals in the regular dining room, but 18, who were aged, crippled, or infirm, did not come there, though they received the same diet as those served in the dining room. During the week of this study 5 patients received at times "special" or "sick" diet, but the amount of such foods was small.

This study began with breakfast, February 20, 1903, and continued 7 days. The total number of meals taken was 3,549, equivalent to 1 man for 1,183 days.

The following menu was served during this study:

FRIDAY, FEBRUARY 20, 1903.

Breakfast.—Boiled salt cod, steamed potatoes, hot rolls, butter, coffee.

Dinner.—Bean soup, baked haddock with dressing, macaroni and tomatoes, boiled rice, finger rolls, steamed pudding with sauce, bread.

Supper.—Evaporated peach sauce, head-cheese,[a] bread, butter, tea.

SATURDAY, FEBRUARY 21, 1903.

Breakfast.—Fried hominy, beefsteak, bread, butter, coffee.

Dinner.—Boiled beef, mashed turnips, steamed potatoes, soup, bread.

Supper.—Roast beef,[a] apple jelly, Graham bread, butter, tea.

SUNDAY, FEBRUARY 22, 1903.

Breakfast.—Baked beans, hash, fried ham,[a] wheat breakfast food, bread, butter, coffee.

Dinner.—Roast beef, steamed potatoes, stewed tomatoes, apple pie, biscuit, bread, butter, coffee.

Supper.—Stewed peaches, plain cake, bread, butter, tea.

MONDAY, FEBRUARY 23, 1903.

Breakfast.—Pork sausage, hominy, bread, butter, coffee.

Dinner.—Bean soup, boiled shoulder, steamed potatoes, boiled rice, bread.

Supper.—Cinnamon bread, prune sauce, cold boiled shoulder,[a] bread, butter, tea.

TUESDAY, FEBRUARY 24, 1903.

Breakfast.—Oatmeal, liver and bacon, bread, butter, coffee.

Dinner.—Beef stew, boiled beets, steamed pudding with sauce, bread or rolls, butter, coffee.

Supper.—Chops,[a] evaporated apple sauce, soda biscuit, butter, tea.

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[a] For working patients.

WEDNESDAY, FEBRUARY 25, 1903.

Breakfast.—Beef stew, oatmeal, rolls, butter, coffee.
Dinner.—Bean soup, corn beef, boiled rice, cucumber pickles, soda biscuit.
Supper.—Pork shoulder,[a] rhubarb sauce, gingerbread, bread, butter, tea.

THURSDAY, FEBRUARY 26, 1903.

Breakfast.—Boiled mush, hash, evaporated-apple sauce, hot rolls, butter, coffee.
Dinner.—Beef potpie, boiled Lima beans, bread, butter, coffee.
Supper.—Baked beans, mutton chops,[a] bread, butter, tea.
Milk and sugar provided as usual.

The statistics regarding the kinds and total amounts of food in this study are given in detail in Table 35 of the Appendix. The following table summarizes the results of the study with regard to the quantities of nutrients and energy per man per day in the food eaten and rejected:

TABLE 14.—*Nutrients and energy in food eaten and wasted in dietary study No. 374.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	19	18		236	1	1		13
Pork	11	18	1	208	1	1		13
Fish	4	2	1	38	2			8
Butter		18		160		3		27
Total animal food	34	56	2	642	4	5		61
Cereals	37	8	226	1,123	5	1	32	157
Sugars and starches			7	28				
Vegetables	10	4	44	252	2		9	44
Fruits	1		34	140			6	24
Total vegetable food	48	12	311	1,543	7	1	47	225
Miscellaneous food	16	16	36	351	1	2	2	29
Total food	98	84	349	2,536	12	8	49	315

It is difficult to decide just what should be the dietary standard for the average man in this department, as the patients were really divided by their degree of activity into two classes—i. e., those who did considerable hard work and those who took little exercise, yet they were fed as one class except that the working patients received an extra allowance of meat once a day, as is the general rule of the institution.

The calculation of the results in the table above, which shows 98 grams of protein and 2,536 calories of energy per man per day in the food consumed, was made on the assumption that all patients were fed alike. In this case the food consumption for the working patients would appear to be too small, while that for the others would seem larger than was necessary. As a matter of fact, however, there was some difference in the food consumption of the two classes, as may be seen from the results obtained by slightly altering the method of computing the average food consumption and separating the workers from the nonworkers. Instead of adding the amount of the extra ration of meat served to the working patients to the ration served to all alike and dividing the whole quantity by the total number of patients fed, as was done in the computation summarized in the table above, the total food consumed according to the regular menu may be divided by the total number of patients, giving an average of 90 grams of protein and 2,402 calories of energy, which would represent the food consumption of the nonworkers. The total quantity of nutrients and energy in the extra meat consumed should then be divided by the number of workers to whom it was fed, to get the average amount per working patient. This added to the before-mentioned values would give 108 grams of protein and 2,694 calories of energy as the average consumption for the workers. This method of computation, it is believed, gives values that are more nearly correct for the two classes than the average in the table above, since aside from the extra allowance of meat for the workers both classes received about the same quantity of food in their ration, as nearly as could be observed.

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[a] For working patients.

During the time of this study the attendants repeatedly sent back to the kitchen for an additional supply of food. This would indicate that the quantities ordinarily supplied to this dining room were not sufficient to meet the demands of the patients. The attendant in charge of the dining room said that the quantity of meat supplied was seldom sufficient to satisfy the patients. The quantity of food eaten by the nonworkers was equal to the standard of 90 grams of protein and 2,450 calories of energy, which is commonly considered sufficient for a man in health with little muscular exercise. The quantity of protein and energy in the food eaten by the working patients was somewhat below that of the common standard for a man at moderately active muscular work, namely 125 grams of protein and 3,400 calories of energy. If the total amount of food served (i. e., food eaten plus food rejected) had been eaten, the protein consumption of the workers would have been nearly equivalent to amount in the standard mentioned, but the energy would still have been a little lower.

The amount of food rejected by the patients during this study contained 11 per cent of the total protein and energy of the food served, noticeably smaller proportions than were observed in some of the preceding studies. The attendant in charge of this dining room stated that the amount rejected was, as a rule, very small. It was suggested to the observer during the time these studies were in progress that the amount rejected was rather less than usual because the patients were given more time to eat than had formerly been the case. While this opinion could not be verified, there may have been a general tendency on the part of the attendants to make the patients hurry through their meals, particularly supper.

Much care was taken in this dining room to return all unserved food, but the amounts returned were small, for the reason that practically all the food provided was served. From the statistics in Table 35 of the Appendix it will be noticed that only a few articles were rejected in large proportions. Boiled salt cod evidently was not relished; neither was wheat breakfast food.

DIETARY STUDY NO. 375—INFIRM MALE PATIENTS.

This study was made with 47 male patients from middle life to old age, more or less infirm, more than 50 per cent of them being parole patients—that is, being at liberty to walk about the grounds unattended. A few did light work in the ward and dining room, but most of them were almost entirely idle. They occupied the ground floor of the Dawes building, called "Dawes basement," and were supplied with food from the general kitchen.

The study began with breakfast, March 4, 1903, and continued 7 days, with 21 meals. The total number of meals taken was 991, equivalent to 1 man for 330 days. The menu during the week of the study was as follows:

WEDNESDAY, MARCH 4, 1903.

Breakfast.—Oatmeal, hot rolls, beef stew, butter, coffee.

Dinner.—Corned beef, crackers, bean soup, bread, steamed potatoes, boiled cabbage.

Supper.—Evaporated-apple sauce, bread, gingerbread, butter, tea.

THURSDAY, MARCH 5, 1903.

Breakfast.—Evaporated-peach sauce, hot rolls, butter, coffee.

Dinner.—Beef stew with dumplings, boiled kidney beans, bread, butter, coffee.

Supper.—Finger rolls, baked beans, butter, tea.

FRIDAY, MARCH 6, 1903.

Breakfast.—Steamed potatoes, boiled salt cod, hot rolls, butter, coffee.

Dinner.—Boiled rice, baked haddock, crackers, bread, steamed potatoes, cottage pudding with sauce, soup.

Supper.—Bread, butter, tea, rhubarb sauce.

SATURDAY, MARCH 7, 1903.

Breakfast.—Fried hominy, corn bread, bread, beefsteak, butter, coffee.

Dinner.—Vegetable soup, bread, boiled beef, steamed potatoes, crackers, fried mush.

Supper.—Ginger cookies, apple jelly, bread, butter, tea.

SUNDAY, MARCH 8, 1903.

Breakfast.—Baked beans, wheat breakfast food, bread, butter, coffee.

Dinner.—Bread, stewed corn, roast beef and dressing, steamed potatoes, apple pie, coffee, butter.

Supper.—Bread, cake, stewed peaches, butter, tea.

Monday, March 9, 1903.

Breakfast.—Fried sausage, hot rolls, hominy, butter, coffee.

Dinner.—Crackers, boiled pork shoulders, boiled turnips, boiled rice, bean soup, bread.

Supper.—Rhubarb sauce, cinnamon bread, bread, butter, tea.

Tuesday, March 10, 1903.

Breakfast.—Liver and bacon, wheat breakfast food, biscuit, butter, coffee.

Dinner.—Beef stew, boiled hominy and beans, bread pudding, bread, butter, coffee.

Supper.—Jelly, rolls, butter, tea.

No separate account was taken of a small amount of special diet served in this dining room during the study. The detailed statistics regarding kinds and amounts of food are given in Table 35 of the Appendix. In the following table are summarized the calculations of the quantities of nutrients and energy per man per day in the food eaten and rejected:

Table 15.—*Nutrients and energy in food eaten and wasted in dietary study No. 375.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	10	10	....	129	6	6	....	77
Pork	3	7	....	74	2	3	....	36
Fish	6	2	....	42	5	1	....	28
Butter	1	49	....	440	....	6	....	53
Total animal food	20	68	....	685	13	16	....	194
Cereals	26	8	166	839	9	3	56	287
Sugars and starches	....	....	7	28	....	....	....	....
Vegetables	7	2	36	190	4	1	20	105
Fruits	1	....	17	72	1	....	17	72
Total vegetable food	34	10	226	1,129	14	4	93	464
Miscellaneous food	10	13	27	264	1	2	4	38
Total food	64	91	253	2,078	28	22	97	696

The food consumption was smaller than would have been expected. The average, 64 grams of protein and 2,078 calories of energy per man per day, is much smaller than the commonly accepted American standard for a man with little or no muscular work, which calls for 90 grams of protein and 2,450 calories of energy. Such a comparison would suggest the question whether these patients ate enough to satisfy their bodily needs. On the other hand, the quantity of food rejected was large, containing 28 grams of protein and 696 calories of energy per man per day, or respectively 30 and 28 per cent of the total in the amount served. Inasmuch as the supply was ample and the proportions rejected were large, the fact that the food consumption of the patients was small indicates either that they ate sufficient amounts or that the food was not suited to their tastes. It seems probable, however, that even if they did not like certain foods they could have readily satisfied their appetites from those which they liked, as it is almost certain that no person would go hungry on the abundant diet provided. It is, therefore, believed that the patients ate as much as their appetites and bodily wants made necessary.

From a consideration of the statistics in Table 35 of the Appendix regarding the rejection of individual food materials, it would seem that the supply of some of the foods was somewhat excessive, as a considerable number of them were rejected in large proportions. The crackers served to the patients in this ward were seldom eaten. Wheat breakfast foods were not relished, and the proportions rejected were very large. The men seemed to desire meat rather than cereal or vegetable food, yet the amount of some of the meats rejected was also large. All things considered, there was apparently an oversupply of food, though the amount supplied was not much greater than called for by the previously mentioned standard for men in health with little or no muscular work.

It was noticeable that only a part of the surplus food was returned from this ward to the kitchen. At the conclusion of the study the superintendent thoroughly investigated the matter. It was found that in this and some other wards bread and meat were the only articles regularly returned to the kitchen while a considerable amount of good edible food, that might have been utilized again, was not returned because of what appeared to be a misunderstanding. The attendants claimed that they had orders to wash all dishes before returning them; hence, as they could not send back any dirty tins they had to throw away the food. It is probable that considerable amounts, much of which might have been utilized again, were not saved. For instance, it is probably safe to say that from 50 to 100 pounds of boiled rice, which could to great advantage be used in soup, was rejected in this way every time it was served. Evidently there was need of attention to the matter of returning unserved food to the kitchen. A knowledge of ways of utilizing such food was also needed, since but little provision was made for this in the dietetic management of the different departments.

DIETARY STUDY NO. 376—DISTURBED MALE PATIENTS.

This study was made with 30 rather disturbed male patients occupying Gray Ash ward, 23 of whom ate in the dining room and the others in the ward.

The study began with breakfast, Wednesday, March 4, 1903, and continued 7 days, with 21 meals. The total number of meals taken was 632, equivalent to 1 man for 211 days.

The menu was the same as in the study preceding and very little special diet was served in addition. The statistics regarding the kinds and amounts of food are given in detail in Table 35 of the Appendix.

The following table summarizes the results showing the quantities of nutrients and energy per man per day in the food eaten and rejected:

TABLE 16.—*Nutrients and energy in food eaten and wasted in dietary study No. 376.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	12	12	....	155	6	6	....	77
Pork	3	7	....	74	2	3	....	35
Fish	2	2	....	26	3	1	....	21
Butter	1	46	....	413	....	10	....	89
Total animal food	18	67	....	668	11	20	....	222
Cereals	26	8	168	847	11	2	69	338
Sugars and starches	....	....	11	44	....	....	....	....
Vegetables	9	4	39	228	4	1	19	101
Fruits	1	....	39	160	....	....	7	28
Total vegetable food	36	12	257	1,279	15	3	95	467
Miscellaneous food	11	13	37	308	3	3	2	46
Total food	65	92	294	2,255	29	26	97	735

The results, it will be noted, are very similar to those in the preceding study with patients of a similar class as regards activity, the food consumption being small and the amounts rejected relatively large. The quantity of protein in the food consumed was practically the same in both studies, but the quantity of energy was larger in the present case.

The large proportions of food wasted were probably owing in part to the fact that the rejection of food is likely to be larger with patients of this class than with some others in better mental condition. It would hardly seem, however, that the unavoidable waste need be as large as in the present study, in which 31 per cent of the food provided was rejected, as shown in Table 35 of the Appendix. The high percentage in the case of such a large number of different articles suggests that the amounts provided were much larger than needed. Very little food was returned to the kitchen during this study, and it would seem that the amount rejected might have been materially diminished by noting carefully the average consumption and making the supply agree more closely with it.

DIETARY STUDY NO. 377—CHRONIC MALE PATIENTS.

This study was made with 42 chronic male patients, in a dining room of Dawes second ward, which, like the wards included in the two preceding studies, was supplied from the general kitchen. A considerable number of the men in this ward did light work.

The study began with breakfast, Wednesday, March 4, 1903, and continued 7 days, with 21 meals. The total number of meals taken was 872, equivalent to 1 man for 291 days.

The same menu was served as during the two preceding studies. The detailed statistics of kinds and amounts of food are given in Table 35 of the Appendix. The data regarding the quantities of nutrients and energy per man per day in the food eaten and rejected are summarized in the following table:

TABLE 17.—*Nutrients and energy in food eaten and wasted in dietary study No. 377.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	15	15	....	194	5	5	....	65
Pork	4	10	....	105	2	3	....	36
Fish	3	1	....	21	2	1	....	16
Butter	1	58	....	520	....	3	....	26
Total animal food	23	84	....	840	9	12	....	143
Cereals	34	10	219	1,101	7	1	46	221
Sugars and starches	....	....	8	32	....	....	....	....
Vegetables	11	4	48	272	3	1	13	73
Fruits	1	....	30	124	....	....	9	36
Total vegetable food	46	14	305	1,529	10	2	68	330
Miscellaneous food	12	14	29	288	3	2	5	49
Total food	81	112	334	2,657	22	16	73	522

It was the opinion of the attendant in charge that these men were light eaters. The results, as summarized above, show that, as compared with some of the other groups, such was actually the case, there being but 81 grams of protein and 2,657 calories of energy per man per day in the food consumed. These amounts were, however, somewhat larger than in either of the two preceding studies. As before, it was believed that the men ate all they needed.

The food rejected contained 21 per cent of the total protein and 16 per cent of the total energy of the food served, or less than in the two preceding studies, but still more than seemed necessary. A large proportion of the waste protein came from meat. It will be seen from the data in Table 35 of the Appendix that the wheat breakfast food, as in other studies, was largely rejected, the proportion in this case, 71 per cent of the amount provided, being even larger than usual. A very large part of the boiled "hominy and beans" was also rejected. Apparently these foods were not relished. It is interesting to note, however, that nearly half of the total protein and more than half of the total carbohydrates consumed was supplied by cereals. The total quantity of protein from vegetable food was twice that from animal food, a proportion which is quite uncommon, as shown by the results of dietary studies made with families.[a] In consideration of the large proportion of meat rejected it would seem that these patients depended largely upon vegetable foods, and particularly upon cereals, for their nourishment.

DIETARY STUDY NO. 378—AGED CHRONIC MALE PATIENTS.

This study was made with 21 patients in the dining room of Dawes first ward, who were for the most part old men, chronic cases and quiet, some of whom did a little light work, such as taking care of the dining room, cleaning the ward, etc. There were altogether about 50 men in this ward, but as many of them were sick patients and received a special diet, they were not all included in the study.

The study began with breakfast, Tuesday, March 17, 1903, and continued 7 days, with 21 meals. The total number of meals taken was 432, equivalent to 1 man for 144 days.

The menu for the week of the study was as follows:

TUESDAY, MARCH 17, 1903.

Breakfast.—Fried liver and bacon, wheat breakfast food, hot rolls, butter, coffee.

Dinner.—Corned beef, steamed potatoes, macaroni, fresh apples, bread, butter, coffee.

Supper.—Rhubarb sauce, soda biscuits, bread, butter, tea.

WEDNESDAY, MARCH 18, 1903.

Breakfast.—Oatmeal, beef stew, hot rolls, butter, coffee.

Dinner.—Bean soup, fresh fried herring, boiled rice, steamed potatoes, crackers, bread.

Supper.—Apple sauce, gingerbread, bread, butter, tea.

THURSDAY, MARCH 19, 1903.

Breakfast.—Evaporated peach sauce, boiled mush, hot rolls, butter, coffee.

Dinner.—Beef potpie, boiled onions, bread, butter, coffee.

Supper.—Baked beans, finger rolls, butter, tea.

FRIDAY, MARCH 20, 1903.

Breakfast.—Salt mackerel, steamed potatoes, biscuit, butter, coffee.

Dinner.—Bean soup, fried fresh herring, boiled rice, cucumber pickles, bread pudding, crackers, bread.

Supper.—Fresh apples, bread, butter, tea, fish.

SATURDAY, MARCH 21, 1903.

Breakfast.—Beef steak, fried hominy, bread, butter, coffee.

Dinner.—Vegetable soup, steamed potatoes, boiled turnips, boiled beef, crackers, bread.

Supper.—Apple jelly, ginger cakes, bread, butter, tea.

SUNDAY, MARCH 22, 1903.

Breakfast.—Baked beans, wheat breakfast food, biscuit, butter, coffee.

Dinner.—Roast beef with gravy and dressing, steamed potatoes, stewed tomatoes, fresh apples, bread, butter, coffee.

Supper.—Evaporated peach sauce, plain cake, bread, butter, tea.

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[a] Connecticut Storrs Station Rpt. 1899, p. 80.

MONDAY, MARCH 23, 1903.

Breakfast.—Fried sausage, fried hominy, biscuit, butter, coffee.

Dinner.—Bean soup, boiled pork shoulder, steamed potatoes, boiled rice, soda crackers, bread.

Supper.—Prune sauce, cinnamon bread, butter, bread, tea.

Sugar and milk as usual. Bread served ad libitum.

The statistics regarding the kinds and amounts of food are given in detail in Table 35 of the Appendix. Table 18 summarizes the computations of the quantities of nutrients and energy per man per day in the food eaten and rejected.

TABLE 18.—*Nutrients and energy in food eaten and wasted in dietary study No. 378.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	10	9	....	120	3	3	....	39
Pork	4	10	....	105	1	2	....	22
Fish	13	13	2	176	2	2	....	26
Butter	....	24	....	213	....	8	....	71
Total animal food	27	56	2	614	6	15	....	158
Cereals	36	10	227	1,141	6	1	38	185
Sugars and starches	....	....	33	132	....	....	....	....
Vegetables	10	4	52	284	5	2	21	122
Fruits	1	1	49	209	1	....	16	68
Total vegetable food	47	15	361	1,766	12	3	75	375
Miscellaneous food	10	11	14	194	1	1	....	12
Total food	84	82	377	2,574	19	19	75	545

The average food consumption, 84 grams of protein and 2,674 calories of energy per man per day, was practically the same as that in the study preceding. In consideration of the physical condition and occupation of these patients it was believed that they ate fully enough to meet their bodily needs, especially since more was served to them than they consumed and no complaints were heard concerning their food.

The amount of food rejected was sufficient to supply 19 grams of protein and 555 calories of energy per man per day, or 18 per cent of the protein and 17 per cent of the energy in the total food served. During this study it is believed that the attendants were more careful than usual to return unserved food to the kitchen, and the quantity thus returned was considerable. It has already been explained, however, that there was in general little provision for the utilization of many of the foods thus returned.

DIETARY STUDY NO. 379—DISTURBED MALE PATIENTS.

This study, which is very similar in detail to the preceding, was made with male patients of a disturbed class, but in fair physical health, occupying White Ash ward. Some of them ate in the dining room and some in the ward. At the beginning of the study there were 40 men in the group, but during the latter part of it 10 were transferred to another ward. Only 4 of these patients did any work, the amount in every case being very small.

The study began with breakfast, March 17, 1903, and continued 7 days, with 21 meals. The total number of meals taken was 802, equivalent to 1 man for 267 days.

The menu served was the same as in the previous study. The detailed statistics of the kinds and amounts of food are given in Table 35 of the Appendix. The quantities of nutrients and energy per man per day in the food eaten and rejected are shown in Table 19 below. Some difficulty was experienced in separating the different kinds of foods in the material rejected, but the data obtained are believed to be reliable.

TABLE 19.—*Nutrients and energy in food eaten and wasted in dietary study No. 379.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	16	16	....	206	1	1	....	13
Pork	4	9	....	96	2	3	....	35
Fish	20	21	4	283	2	2	....	25
Butter	....	35	....	312	....	....	....	....
Total animal food	40	81	4	897	5	6	....	73
Cereals	41	10	256	1,277	4	1	24	121
Sugars and starches	....	....	6	24	....	....	....	....
Vegetables	12	5	52	301	3	....	10	52
Fruits	1	1	45	192	....	....	4	16
Total vegetable food	54	16	359	1,794	7	1	38	189
Miscellaneous food	10	11	12	186	1	1	....	13
Total food	104	108	375	2,877	13	8	38	275

The average quantity of protein, 104 grams, and of energy, 2,877 calories, per man per day in the food consumed by this group is larger than that of the previously mentioned standard for a man in health with little or no muscular work, but perhaps no larger than was to be expected when it is remembered that the men were generally more or less nervous and disturbed. It is noticeably higher than the average observed in some of the studies immediately preceding, which may perhaps be accounted for by the differences in physical condition and muscular exertion, which for some of the patients in the present study was perhaps considerable during their violent periods.

The total amount of food rejected during this study was only 12 per cent of that provided, and contained only 11 per cent of the total protein and 9 per cent of the total energy of the food served, proportions much smaller than in some of the preceding studies. In general the amounts of food provided seemed to be but little larger than were needed, though in a few cases there was considerable left after the patients were served, the excess being returned to the kitchen.

DIETARY STUDY NO. 380—QUIET CHRONIC MALE PATIENTS.

This study was made with 38 male patients who ate in the dining room of Dawes third ward. Seventeen of them were classed as workers, 9 working in the hospital laundry, 1 doing carpenter work, and 7 others being occupied for part of the time in light ward and dining-room work. They were mostly chronic patients, and were quiet and orderly.

The study began with breakfast, March 17, 1903, and continued 21 days, simultaneously with Nos. 378 and 379. The total number of meals eaten was 819, equivalent to 1 man for 273 days.

The same menu was served during this study as in the two preceding. Statistics regarding the kinds and amounts of food are given in detail in Table 35 of the Appendix. The quantities of nutrients and energy per man per day in the food eaten and rejected are given in the following table:

TABLE 20.—*Nutrients and energy in food eaten and wasted in dietary study No. 380.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	14	14		181	2	2		26
Pork	4	10		105				
Fish	15	15	3	206	3	3	1	42
Butter		33		293		1		9
Total animal food	33	72	3	785	5	6	1	77
Cereals	39	10	239	1,201	2		13	60
Sugars and starches			10	40				
Vegetables	10	4	42	244	3	1	14	77
Fruits	1	1	43	184			8	32
Total vegetable food	50	15	334	1,669	5	1	35	169
Miscellaneous food	9	10	12	173	1	1		13
Total	92	97	349	2,627	11	8	36	259

The average food consumed was sufficient to supply 92 grams of protein and 2,627 calories of energy per man per day, amounts which appeared to be abundant for the needs of the patients. The results obtained are comparable with those of studies Nos. 364, 372, and 378, and show about the same food consumption, which would appear to be about the normal amount at this institution for patients of this class.

The total amount of food rejected was only 10 per cent of that provided, which is even less than was observed in the study preceding, though it contained the same proportion of protein and energy, namely, 11 and 9 per cent, respectively, of the total in food served.

The excess of total food provided over what was needed to serve the patients was considerably larger in this study than in the preceding. It was noted that the attendant in charge of this dining room took special pains to return to the kitchen all food not served, and in all respects the dining room appeared to be particularly well managed.

DIETARY STUDY NO. 381—MALE PATIENTS, YOUNG AND ORDERLY.

This study was made with 30 patients in "Beech" ward, mostly young men who were quiet and orderly, and many of whom would probably recover. Of this number 15 were parole patients, most of them at work in the laundry, tailor shop, mattress shop, etc.

The study began with breakfast, March 30, 1903, and continued for 7 days, with 21 meals. The total number of meals taken was 615, equivalent to 1 man for 205 days.

The following menu was served during the week of this study:

MONDAY, MARCH 30, 1903.

Breakfast.—Fried sausage, hominy, hot rolls, butter, coffee.

Dinner.—Bean soup, boiled shoulders, boiled kale, boiled rice, crackers, bread.

Supper.—Apple sauce, hash, doughnuts, bread, butter, tea.

TUESDAY, MARCH 31, 1903.

Breakfast.—Oatmeal, liver and bacon, bread, butter, coffee.

Dinner.—Corned beef, steamed potatoes, boiled Lima beans, bread pudding, bread, butter, coffee.

Supper.—Fried liver and bacon, stewed prunes, soda biscuit, butter, tea.

WEDNESDAY, APRIL 1, 1903.

Breakfast.—Oatmeal, beef stew, hot rolls, butter, coffee.

Dinner.—Bean soup, fresh herring, stewed canned corn, steamed potatoes, crackers, bread.

Supper.—Beef stew, apple sauce, gingerbread, bread, butter, tea.

THURSDAY, APRIL 2, 1903.

Breakfast.—Baked hash, corn-meal mush, evaporated-peach sauce, gingerbread, biscuit, butter, coffee.

Dinner.—Beef potpie, boiled beans, bread, butter, coffee.

Supper.—Baked beans, beef potpie, finger rolls, butter, tea.

FRIDAY, APRIL 3, 1903.

Breakfast.—Salt mackerel, steamed potatoes, biscuit, butter, coffee.

Dinner.—Bean soup, baked fresh shad, boiled macaroni, cottage pudding with sauce, boiled rice, crackers, bread.

Supper.—Beef stew, prune sauce, bread, butter, tea.

SATURDAY, APRIL 4, 1903.

Breakfast.—Beefsteak, hominy, bread, butter, coffee.

Dinner.—Vegetable soup, boiled beef, steamed potatoes, boiled kale, bread, crackers.

Supper.—Apple jelly, beef stew, Graham bread, ginger cakes, butter, tea.

SUNDAY, APRIL 5, 1903.

Breakfast.—Wheat breakfast food, fried ham, baked beans, biscuit, butter, coffee.

Dinner.—Roast beef, steamed potatoes, boiled rice, apple pie, bread, butter, coffee.

Supper.—Apple sauce, cake, bread, butter, tea.

Bread served ad libitum. Sugar was supplied at each meal. Two quarts of milk was served to the ward morning and night.

The data regarding the total amounts of food provided, returned, eaten, and rejected are given in Table 35 of the Appendix. The amounts of nutrients and energy per man per day in the food eaten and rejected are shown in Table 21.

TABLE 21.—*Nutrients and energy in food eaten and wasted in dietary study No. 381.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	17	17	....	219	2	2	....	26
Pork	7	13	....	144	1	2	....	22
Fish	11	12	2	159	2	2	....	25
Butter	....	32	....	285	....	....	....	....
Milk	4	5	7	88	....	....	....	....
Total animal food	39	79	9	895	5	6	....	73
Cereals	34	12	211	1,087	2	1	15	77
Sugars and starches	....	....	17	68	....	....	....	....
Vegetables	13	6	52	313	1	....	2	12
Fruits	....	....	26	104	....	....	4	16
Total vegetable food	47	18	306	1,572	3	1	21	105
Miscellaneous food	24	35	32	536	4	5	3	73
Total food	110	132	347	3,003	12	12	24	251

The average food consumption shown by the results in the above table, 110 grams protein and 3,003 calories energy, are very nearly the amounts called for by the commonly accepted American dietary standard for a man in health at light to moderate muscular work. The indications are, therefore, that these patients were amply nourished.

The quantity of food left on the plates by these patients was ordinarily very small, the total amount of food rejected being but 7 per cent of that provided, or 10 per cent of the total protein and 8 per cent of the total energy of the food served. In the case of many foods, however, the proportions returned to the kitchen, after the patients had been served, were large, as the quantity sent to the dining room was much in excess of what was needed by the patients. The data given in

Table 35 of the Appendix show that 35 per cent of the boiled beef, 36 per cent of the hominy, 45 per cent of the rice, and similarly large proportions of a number of other materials were returned.

DIETARY STUDY NO. 382—MALE PATIENTS, YOUNG, QUIET, AND ORDERLY.

Sycamore ward, in which this study was made, accommodates about 30 patients; during the study the number varied from 26 to 33. They were chiefly young men, many of them parole patients, quiet and orderly, some of whom would doubtless be cured. Seven of them were workers.

The study was carried on simultaneously with No. 381 and the menu served was the same. The total number of meals taken was 617, equivalent to 1 man for 206 days.

The statistics of kinds and amounts of food are given in detail in Table 35 of the Appendix. The following table shows the quantities of nutrients and energy per man per day in the food eaten and rejected:

Table 22.—*Nutrients and energy in food eaten and wasted in dietary study No. 382.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Energy.	Protein.	Fat.	Carbohydrates.	Energy.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	11	11	....	142	2	2	....	26
Pork	5	10	....	109	1	2	....	22
Fish	9	10	1	129	2	2	....	26
Butter	....	32	....	284	....	....	....	....
Milk	4	5	7	89	....	....	....	....
Total animal food	29	68	8	753	5	6	....	74
Cereals	33	11	208	1,062	2	....	14	64
Sugars and starches	....	....	22	88	....	....	....	....
Vegetables	12	5	50	292	....	....	....	....
Fruits	1	....	28	116	....	....	4	16
Total vegetable food	46	16	308	1,558	2	....	18	80
Miscellaneous food	23	34	32	523	5	8	3	103
Total food	98	118	348	2,834	12	14	21	257

The food consumption, averaging 98 grams protein and 2,834 calories of energy per man per day, was somewhat smaller than that observed for similar patients in the preceding study, the difference being doubtless partly due to the smaller proportion of working patients in the present group. The food appeared to be entirely satisfactory, the quantities left on the plates were small, and the indications were that the patients ate all they needed. If such had not been the case the amounts sent to the dining room were large enough to have provided much more than they ate. In this study, as in the preceding, much care was taken to return all unserved food to the kitchen.

DIETARY STUDY NO. 383—CHRONIC MALE PATIENTS AND IDIOTS.

This study was made with 24 patients, all males, but of varying ages, some being children and some old men. A few were fairly quiet and orderly chronic patients while others were idiots or at least had very little mental capacity. There were very few disturbed patients. Five of the men were classed as workers, but several others performed some light work, usually about the ward.

This study was made at the same time as the two preceding and the menu was the same. The total number of meals taken was 501, equivalent to 1 man for 167 days.

The statistics of kinds and amounts of food are given in detail in Table 35 of the Appendix. The quantities of nutrients and energy per man per day in the food eaten and rejected are summarized in the following table:

Table 23.—*Nutrients and energy in food eaten and wasted in dietary study No. 383.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	11	11	...	142	3	3	...	39
Pork	5	11	...	118	...	1	...	8
Fish	12	13	2	172	1	1	...	13
Butter	...	28	...	249	...	11	...	98
Milk	5	7	8	114	...	...	...	...
Total animal food	33	70	10	795	4	16	...	158
Cereals	38	13	239	1,224	4	1	26	129
Sugars and starches	...	...	20	80	...	...	...	...
Vegetables	13	5	48	288	1	...	4	20
Fruits	1	...	40	164	...	...	1	4
Total vegetable food	52	18	347	1,756	5	1	31	153
Miscellaneous food	10	13	26	260	1	1	2	21
Total food	95	101	383	2,811	10	18	33	332

The average food consumption, 95 grams of protein and 2,811 calories of energy per man per day, in this study was practically equal to the previously mentioned dietary standard for a man in health with sedentary occupation. Apparently the patients were abundantly nourished, though it may be that they ate no more than they needed. The quantity of food which they rejected contained 10 per cent of the protein and 11 per cent of the energy of the total food served. Large proportions of many of the staple foods were returned to the kitchen during this study, indicating that the amounts sent to the dining room were considerably in excess of what was required.

DIETARY STUDY NO. 384—MALE PATIENTS, NOT VIOLENT.

This study was made with about 30 male patients, from middle-aged to old men, occupying a ward known as "Garfield basement." They were more or less untidy; most of them decidedly demented, but not violent. Several of them did ward and dining-room work, but as a whole their physical activity appeared to be very slight. The men studied were all supplied with the regular diet, none being sick, though a number of them appeared to be quite feeble.

The study began with breakfast, April 16, 1903, and continued for 7 days, with 21 meals. The total number of meals taken was 632, equivalent to 1 man for 211 days.

The menu served during the week of this study was as follows:

THURSDAY, APRIL 16, 1903.

Breakfast.—Oatmeal, apple jelly, bread, butter, coffee.

Dinner.—Beef potpie, kidney beans, boiled rice, bread, butter, coffee.

Supper.—Baked beans, finger rolls, butter, tea.

FRIDAY, APRIL 17, 1903.

Breakfast.—Salt mackerel, steamed potatoes, hot rolls, butter, coffee.

Dinner.—Bean soup, fried fresh herring, macaroni and tomato, steamed potatoes, evaporated-peach pie, crackers, bread.

Supper.—Prune sauce, bread, butter, tea.

SATURDAY, APRIL 18, 1903.

Breakfast.—Hominy, beefsteak, bread, butter, coffee.

Dinner.—Vegetable soup, boiled beef, boiled kale, steamed potatoes, crackers, bread.

Supper.—Apple jelly, ginger cakes, Graham bread, butter, tea.

SUNDAY, APRIL 19, 1903.

Breakfast.—Wheat breakfast food, baked beans, biscuit, butter, coffee.

Dinner.—Roast beef with gravy and dressing, steamed potatoes, stewed tomatoes, evaporated-apple pie, bread, butter, coffee.

Supper.—Evaporated-apple sauce, cake, bread, butter, tea.

MONDAY, APRIL 20, 1903.

Breakfast.—Boiled hominy, fried sausage, bread, butter, coffee.

Dinner.—Bean soup, boiled shoulder, steamed potatoes, boiled rice, crackers, bread.

Supper.—Rhubarb sauce, cinnamon bread, bread, butter, tea.

TUESDAY, APRIL 21, 1903.

Breakfast.—Wheat breakfast food, peach sauce, biscuit, butter, coffee.

Dinner.—Fresh herring, kidney beans, cucumber pickles, bread pudding, bread, butter, coffee.

Supper.—Prune sauce, biscuit, butter, tea.

WEDNESDAY, APRIL 22, 1903.

Breakfast.—Oatmeal, beef stew, rolls, butter, coffee.

Dinner.—Bean soup, corned beef, steamed potatoes, boiled cabbage, crackers, bread.

Supper.—Peach sauce, gingerbread, bread, butter, tea.

Bread served ad libitum with every meal.

The detailed data for the total amounts of food returned, eaten, and rejected during this study are shown in Table 35 of the Appendix. The calculated amounts of nutrients and energy per man per day in the food eaten and rejected are shown in Table 24.

TABLE 24.—*Nutrients and energy in food eaten and wasted in dietary study No. 384.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	10	10	....	129	2	2	....	26
Pork	5	10	....	109	....	....	....	....
Fish	6	7	1	90	2	3	....	35
Butter	....	31	....	276	....	....	....	....
Total animal food	21	58	1	604	4	5	....	61
Cereals	38	10	234	1,177	7	2	41	210
Sugars and starches	....	....	11	44	....	....	....	....
Vegetables	13	3	51	283	1	....	5	24
Fruits	1	....	35	144	....	....	6	24
Total vegetable food	52	13	331	1,648	8	2	52	258
Miscellaneous food	6	12	32	259	1	1	4	28
Total food	79	83	364	2,511	13	8	56	347

In respect to the food consumption, 79 grams of protein and 2,511 calories of energy per man per day, the results of this study are very similar to Nos. 377 and 378, on preceding pages, which were made with patients of about the same general age, activity, and degree of physical health. As was explained in the discussion of the preceding studies, the indications were that the patients ate enough to meet their bodily needs.

The amount of food rejected was larger in proportion to the total amount served than was the case in some of the studies immediately preceding this, but was much smaller than in several of the other studies included in the present report. As shown by the data in Table 35 of the Appendix, the waste was not confined to any given articles but varied considerably in kind and amount from day to day. The proportion of rejected food (10 per cent) is more marked if considered in terms of nutrients and energy rather than in terms of total food.

DIETARY STUDY NO. 385—MALE PATIENTS, QUIET, CHRONIC.

This study was made with about 30 quiet, chronic, male patients, more or less untidy in their habits, who occupied the ward known as "Garfield first." It was made simultaneously with No. 384, and the menu was the same as in that study. The total number of meals taken was 633, equivalent to 1 man for 211 days.

Table 35 of the Appendix shows the total amounts of food provided, eaten, and rejected, and the following table summarizes the computed amounts of nutrients and energy per man per day in the food eaten and rejected:

TABLE 25.—*Nutrients and energy in food eaten and wasted in dietary study No. 385.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	19	19	....	245	1	1	....	13
Pork	6	11	....	122	....	....	....	....
Fish	14	15	2	198	....	....	....	....
Butter	....	31	....	275	....	....	....	....
Total animal food	39	76	2	840	1	1	....	13
Cereals	40	10	246	1,233	2	....	14	64
Sugars and starches	....	....	11	44	....	....	....	....
Vegetables	17	5	66	377	1	....	4	20
Fruits	1	....	54	220	....	....	7	28
Total vegetable food	58	15	377	1,874	3	....	25	112
Miscellaneous food	8	11	30	250	1	1	2	21
Total food	105	102	409	2,964	5	2	27	146

The food consumption, 105 grams of protein and 2,964 calories of energy per man per day, was believed to be entirely adequate to the physiological demands of the patients. There was ample opportunity for the men to eat more had they so desired, because the amounts provided were abundant, as was shown by the fact that considerable food was returned to the kitchen after the men were served.

The proportions of food rejected by these patients was the minimum for the studies here reported, being but 5 per cent of the total food provided, and containing only 5 per cent of the total protein and of the energy in the food served.

DIETARY STUDY NO. 386—MALE PATIENTS, QUIET, CHRONIC.

This study was made with about 30 male patients occupying Garfield second ward, of about the same class and under practically the same conditions as those in the two preceding studies (Nos. 384 and 385). The menu served was the same. The total number of meals served was 616, equivalent to 1 man for 205 days.

Table 35 of the Appendix contains the data regarding food provided, returned, eaten, and rejected during the study. Table 26 shows the calculated amounts of nutrients and energy per man per day contained in the food eaten and rejected.

TABLE 26.—*Nutrients and energy in food eaten and wasted in dietary study No. 386.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	18	18		232	1	1		13
Pork	5	11		118				
Fish	10	11	2	146	1	1		13
Butter		32		285				
Total animal food	33	72	2	781	2	2		26
Cereals	35	9	216	1,084	6	1	37	181
Sugars and starches			11	44				
Vegetables	18	5	72	405			2	8
Fruits	1		53	216			9	36
Total vegetable food	54	14	352	1,749	6	1	48	225
Miscellaneous food	10	13	32	283	1	1	1	17
Total food	97	99	386	2,813	9	4	49	268

The food consumption in this study, 97 grams of protein and 2,813 calories of energy per man per day, is slightly smaller than in the preceding study, but the average in both was considerably larger than that in study No. 384 and others in which the patients had about the same amount of muscular exercise.

The quantity of food rejected was also very small, but was slightly larger than in the preceding study, the difference being comparable with that observed in the food consumption. In other words, the quantity served per man per day was very nearly the same in both studies.

The amounts of food sent from the kitchen to the dining room were much nearer the quantities which were served than was the case in the preceding study, so that the proportions returned to the kitchen were smaller. Taken in connection with the small percentage of food rejected, this would seem to indicate that, whether intentionally or accidentally, the amounts of food provided for the ward were gauged more nearly to the desires of the patients than is usual where special attention has not been given to this matter.

DIETARY STUDY NO. 387—MALE PAROLE PATIENTS.

This study was made in Poplar ward, with about 14 parole patients, most of whom had not been committed to the institution, but came of their own will, some being under treatment for dipsomania and others recovering from the effects of fever, sunstroke, etc. They were quiet and orderly, and gave little sign of mental derangement. Very few of them did any regular work, but all spent a large part of their time out of doors, and must have had considerable muscular exercise.

The study began with breakfast, Saturday, May 2, 1903, and continued 7 days, with 21 meals. The total number of meals taken was 275, equivalent to 1 man for 92 days.

The menu served during the week of the study was as follows:

SATURDAY, MAY 2, 1903.

Breakfast.—Oatmeal, beefsteak, griddle cakes, fried potatoes, biscuit, milk, butter.

Dinner.—Vegetable soup, roast veal, browned potatoes, stewed canned peas, ice cream, bread, crackers, milk.

Supper.—Fried bacon, stewed prunes, baked potatoes, bread, milk.

SUNDAY, MAY 3, 1903.

Breakfast.—Wheat breakfast food, fried ham, steamed and fried potatoes, corn bread, baked beans, rolls, milk.

Dinner.—Tomato soup, baked chicken, mashed potatoes, boiled rice, lemon jelly, milk, bread.

Supper.—Shoulder, lettuce, French fried potatoes, apple sauce, cocoanut cake, bread, milk.

MONDAY, MAY 4, 1903.

Breakfast.—Oatmeal, veal cutlets, baked potatoes, muffins, bread, milk.

Dinner.—Bean soup, roast beef, browned potatoes, boiled macaroni, green onions, floating island pudding, bread, crackers, milk.

Supper.—Hamburg steak, lettuce, biscuit, bread, milk.

TUESDAY, MAY 5, 1903.

Breakfast.—Oatmeal, fried mush, beef steak, fried onions, baked potatoes, bread, milk.

Dinner.—Vegetable soup, baked shoulder, boiled cabbage, boiled potatoes, rice pudding, bread, crackers, milk.

Supper.—Ham omelet, Saratoga chips, lettuce, evaporated peach sauce, bread, milk.

WEDNESDAY, MAY 6, 1903.

Breakfast.—Oatmeal, fried ham, potato cakes, muffins, biscuit, milk.

Dinner.—Vegetable soup, beef stew, boiled Lima beans, mashed potatoes, lemon pie, bread, milk.

Supper.—Fried bacon, baked potatoes, rhubard sauce, toast, bread, milk.

THURSDAY, MAY 7, 1903.

Breakfast.—Oatmeal, fried sausage, fried potatoes, corn bread, bread, oatmeal.

Dinner.—Vegetable soup, beefsteak, mashed potatoes, creamed onions, ice cream, crackers, bread, milk.

Supper.—Cold roast beef, lettuce, apple sauce, baked beans, finger rolls, bread, milk.

FRIDAY, MAY 8, 1903.

Breakfast.—Oatmeal, French fried potatoes, baked hash, fried fresh herring, biscuit, milk.

Dinner.—Clam soup, broiled shad, mashed potatoes, roast beef, slaw, boiled rice, evaporated-peach pie, crackers, bread, milk.

Supper.—Fried eggs, baked potatoes, stewed prunes, biscuit, bread, milk.

Tea or coffee served as desired. Bread served ad libitum with every meal. Butter as usual.

Table 35 of the Appendix gives the data regarding the total amounts of food provided, returned, eaten, and rejected. The following table shows the calculated amounts of nutrients and energy per man per day in the food eaten and rejected during this study:

TABLE 27.—*Nutrients and energy in food eaten and wasted in dietary study No. 387.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	34	28	....	385	4	3	....	43
Pork	14	27	....	296	3	7	....	74
Fish	3	3	1	43	....	....	....	....
Butter	....	15	....	134	....	....	....	....
Milk	13	17	21	287	....	....	....	....
Eggs	2	3	....	35	....	....	....	....
Total animal food	66	93	22	1,180	7	10	....	117
Cereals	25	9	153	792	8	3	43	231
Sugars and starches	....	....	84	336	....	....	....	....
Vegetables	12	13	70	444	4	5	33	192
Fruits	....	....	21	84	....	....	7	28
Total vegetable food	37	22	328	1,656	12	8	83	451
Miscellaneous food	25	29	66	622	4	5	7	89
Total food	128	144	416	3,458	23	23	90	657

The amount of food consumed supplied 128 grams of protein and 3,458 calories of energy per man per day, amounts corresponding to the previously mentioned dietary standard for a man at moderately active muscular work, such for instance as a carpenter or mason or laborer working actively 10 hours per day. While these men were out of doors much of the time and had considerable muscular exercise it is very doubtful if their activity was equal to that called for by the standard quoted. However, they were in general convalescing, or in a condition which may be compared to it, and it is not unlikely that in such condition the demands of the body for nourishment may be influenced by other than the ordinary factors.

DIETARY STUDY NO. 388—MALE PAROLE PATIENTS.

This study was made with 9 male patients occupying Maple ward, and of a class similar to those included in dietary No. 387. Only 2 of these patients performed any regular work, but all of them took some exercise each day.

The study was made at the same time as No. 387, and the menu served was the same. The total number of meals taken was 188, equivalent to 1 man for 63 days.

The data for the total amounts of food provided, returned, eaten, and rejected are given in Table 35 of the Appendix. The following table shows the average amounts of nutrients and energy per man per day in the food eaten and rejected during this study:

TABLE 28.—*Nutrients and energy in food eaten and wasted in dietary study No. 388.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	26	24	....	318	5	3	....	47
Pork	15	28	....	309	2	6	....	61
Fish	4	4	1	55	....	....	....	....
Milk	23	28	35	481	....	....	....	....
Butter	....	31	....	276	....	....	....	....
Eggs	2	2	....	26	....	....	....	....
Total animal food	70	117	36	1,465	7	9	....	108
Cereals	18	8	113	595	8	4	42	236
Sugars and starches	....	....	72	288	....	....	....	....
Vegetables	10	9	64	376	6	9	35	244
Fruits	....	....	15	60	....	....	15	60
Total vegetable food	28	17	264	1,319	14	13	92	540
Miscellaneous food	22	22	59	520	10	13	15	216
Total food	120	156	359	3,304	31	35	107	864

The average quantity of food eaten by these patients, 120 grams of protein and 3,304 calories of energy per man per day, was but a trifle less than in the preceding study, while the amount of food rejected (a total of 18 per cent) was a little higher, the average amount of nutrients and energy in the total food served being about equal in both studies.

The food consumption in these two studies was noticeably larger than that observed in any of the preceding. These men had no more muscular activity than some of the others, and they were not considered to be more hearty eaters. The increase in the quantity of nutrients consumed was probably due to a wider variety in the diet.

DIETARY STUDY NO. 389—OFFICERS AND EMPLOYEES.

This study was made in "Walnut ward" dining room, which supplied food for about 20 employees and officers, including three supervisors (males), three men clerks, several women clerks, and maids employed about the halls. A considerable number lived outside the institution and took only a part of their meals in the dining room.

This study was carried on at the same time as Nos. 387 and 388, and the same menu was served. The total number of meals taken, estimating 1 meal per woman as 0.8 meal per man, was 236, equivalent to 1 man for 79 days.

Table 35 of the Appendix contains the detailed data for the total amounts of food provided, eaten, and rejected. The total amounts of nutrients and energy per man per day in the food eaten and rejected are shown in the following table:

TABLE 29.—*Nutrients and energy in food eaten and wasted in dietary study No. 389.*

[Quantities per man per day.]

Kind of food material.	Food eaten.				Food wasted.			
	Protein.	Fat.	Carbohydrates.	Fuel value.	Protein.	Fat.	Carbohydrates.	Fuel value.
	Grams.	*Grams.*	*Grams.*	*Calories.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
Beef, veal, and mutton	30	27	1	364	4	3		43
Pork	14	23		261	4	8		87
Fish	4	5	1	65				
Milk	31	38	47	650				
Butter		7		62				
Eggs	2	3		35				
Total animal food	81	103	49	1,437	8	11		130
Cereals	24	9	145	756	7	3	38	207
Sugars and starches			86	344				
Vegetables	9	9	63	368	6	7	33	218
Fruits			11	44			21	84
Total vegetable food	33	18	305	1,512	13	10	92	509
Miscellaneous food	26	30	68	643	6	7	15	146
Total food	140	151	422	3,592	27	28	107	785

The result of this study may quite properly be compared with those of studies with attendants reported in this publication; that is, Nos. 365, 369, and 370. As regards food eaten the present study, averaging 140 grams of protein and 3,522 calories of energy per man per day, shows the maximum as regards protein, being 9 grams higher than No. 370 and 40 grams higher than No. 369. In respect to amount of fat eaten it was moderate, and was next to the lowest in respect to carbohydrates. The energy was lower than in the case of No. 370, which, however, was extremely high, owing to the large amount of butter and sugar eaten.

A comparison of the food consumption of the persons here studied with any dietary standard is almost impossible, because the group included employees of both sexes and of varying degrees of muscular activity. Moreover, some worked only from 8 a. m. to 5 p. m., while others were on duty continuously from 8 a. m. to 9 p. m. It hardly seems probable, however, that the demands of these persons for nutrients and energy would be on the average any larger than are called for by the previously mentioned dietary standard for a man at light to moderate muscular work, namely, 112 grams of protein and 3,050 calories of energy per day. It is interesting to note that the results of the study are considerably higher than the standard in respect to both protein and energy. It is reasonably certain, therefore, that these persons had amply sufficient or more than sufficient nourishment.

The amount of food rejected in this study was sufficient to supply

27 grams of protein and 785 calories of energy per man per day, or 16 per cent of the protein and 18 per cent of the energy in the total food served. In this respect the results are similar to those of the two preceding studies with subjects receiving the same diet.

FOOD ISSUED FROM THE STOREROOM.

In connection with these studies of dietaries in different departments of the hospital, it seemed desirable to obtain data regarding the kinds and amounts of food issued from the storeroom to the kitchens of the whole institution. It was not possible to obtain these for the fiscal year during which the dietary studies here reported were conducted, partly for the reason that the last of the studies was completed some time before the end of the year. However, the statistics for the year immediately preceding the time of the studies, namely, from July 1, 1901, to June 30, 1902, were obtained, and it was believed that the nutritive value of the food supplied per capita did not differ materially during the two years.

These statistics are given in detail in Table 36 of the Appendix. It will be observed that they show the amounts issued to the different departments for use in preparing the food, while the data of the studies show the quantities of food served to the patients and eaten and rejected by them. The way in which the statistics here given were obtained may require a brief explanation.

Supplies received at the hospital are placed at once in a general storeroom or "store" as it is designated, and are issued to the different departments upon the receipt of orders signed by an officer of the department in which they are to be used. The order sheets showing the kind and amount of material sent out are filed with a bookkeeper, who enters the items upon a ledger. From these ledgers the statistics were taken concerning the kinds and amounts of food issued during the course of the year.

These figures show the kinds and total amounts of different food materials thus taken from the storeroom and supplied to the several hospital kitchens. The composition of each kind of material was assumed to be the same as the average for several analyses of similar materials as previously published.[a] From these data the total quantities of the different nutrients in the food supplied were calculated.

In order to compute the quantities per man per day it was necessary to know the total number of persons of each sex fed during the year, and the number of meals taken by each. To ascertain this exactly was impossible, because of variation in the population from day to day, owing to deaths, patients discharged, new patients received, and patients or attendants on leave of absence. However, from data showing the average population of the hospital an estimate of attendance was made, allowing for absences, etc., which was believed to be tolerably accurate. According to this estimate, the total attendance of men for the year was 2,123 and of women 734. Assuming that as regards food consumption the number of women would be equivalent to 0.8 as many men, or in round numbers 587, the calculated total number of men for the year would be 2,710, and that number of men for 365 days would be equivalent to 989,150 men for 1 day. Dividing the total quantities of each nutrient in the food supplied by this number gives the equivalent per man per day. These data are summarized herewith:

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.

TABLE 30.—*Estimated amounts of nutrients and energy per man per day in the food issued from the storeroom for 1 year.*

	Protein.	Fat.	Carbohydrates.	Energy.
	Grams.	*Grams.*	*Grams.*	*Calories.*
Animal food	73	164	21	2,271
Vegetable food	54	8	496	1,836
Total food	127	172	517	4,107

It has been explained on page 12 that no studies were made with women patients; hence, nothing is definitely known concerning the relative food consumption of men and women inmates in this institution. The assumption above made that the women would eat 0.8 as much as the men is that commonly made in dietary studies of ordinary families, but in the studies in the New York State hospitals for the insane it was found that with the chronic patients the average amount eaten by women was only about 0.7 of that eaten by men, and with other classes of women patients it was even lower. The results as computed in the present instance are therefore believed to be under rather than over estimates, because if the factor that should be used is lower than 0.8, the equivalent number of men would be smaller than that given above, and the total number of men for one day would be less; consequently the average of nutrients and energy per man per day in the food supplied would be higher than has been computed by the method followed.

SUMMARY AND DISCUSSION.

The principal features of the investigations at the Government Hospital for the Insane, reported in this bulletin, have to do with the study of the quantities of food consumed and wasted by different classes of the hospital population. By comparing the data regarding food consumption with those of similar studies in other institutions, and with dietary standards for persons in normal mental conditions with equivalent amounts of muscular activity, it is possible to judge of the adequacy of the diet; and a comparison of the amounts of food issued with those supplied to the dining rooms and those eaten and wasted affords information concerning the economy in the utilization of food. The statistics regarding food eaten and food wasted are summarized and discussed in the following pages.

The quantities of nutrients and energy per man per day in the total food served—i. e., that eaten and that rejected at the tables—and the proportion of the quantity of each nutrient and of energy in the total served that was rejected are summarized for all the studies at the Government hospital in Table 31. For convenience in the discussion of results the different studies in which the conditions were similar have been grouped together and averaged, and for purposes of comparison the results of studies made in similar institutions elsewhere are also included in the table, as well as dietary standards for persons in health with varying amounts of muscular activity.

A tentative standard for the average population of hospitals for the insane, proposed by Atwater as the result of studies made in the New York State hospitals for the insane,[a] is also given in the table. This standard, which is given in the publication referred to on the basis "per person per day," was proposed for a population consisting of about equal numbers of males and females, in which the food consumption of the latter averaged about 0.7 that of the former. The corresponding values "per man per day," computed in accordance with these data, is also given in the table, as this can be better compared with the results of the studies in the Government hospital, which were almost entirely with men. Such facts as could then be found on record, and the observations in the New York hospitals for the insane, led to conclusions that the standard proposed is decidedly liberal rather than the opposite.

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[a] N. Y. State Com. Lunacy Rpt. 13 (1900-1901), p. 119.

Table 31.—*Summary of results of dietary studies at the Government Hospital for the Insane and other institutions.*

Study No.	Patients.	Number of persons.	Food served.								Proportion of total served that was wasted.			
			Food eaten.				Food wasted.							
			Protein.	Fat.	Carbohydrates.	Energy.	Protein.	Fat.	Carbohydrates.	Energy.	Protein.	Fat.	Carbohydrates.	Energy.
	Studies at Government Hospital for Insane.													
	PATIENTS, MALES.		*Gm.*	*Gm.*	*Gm.*	*Cals.*	*Gm.*	*Gm.*	*Gm.*	*Cals.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
364	Middle to old age, largely chronic, orderly, quiet, few workers.	541	88	112	384	2,885	9	6	35	229	9	5	8	7
372		74	95	98	348	2,644	27	22	112	752	22	18	24	22
373		99	94	93	369	2,680	17	14	63	445	15	13	15	14
375		47	61	91	253	2,078	28	22	97	696	30	19	28	25
377		42	81	112	334	2,657	22	16	73	522	21	13	18	16
378		21	84	82	377	2,674	19	19	75	555	18	19	17	17
380		39	92	97	349	2,627	11	8	36	259	11	8	9	9
384		30	79	83	364	2,511	13	8	56	347	14	9	13	12
385		30	105	102	409	2,964	5	2	27	146	5	2	6	5
386		29	97	99	386	2,813	9	4	49	268	8	4	11	9
	Average	952	88	105	370	2,767	13	10	50	341	13	9	9	11
368	Acute, nervous, and disturbed nonworkers.	26	76	86	378	2,581	26	20	129	798	26	19	25	24
376		30	65	92	294	2,255	29	26	97	735	31	22	25	25
379		38	104	108	375	2,877	13	8	38	275	11	7	9	9
	Average	94	84	97	350	2,599	22	17	82	567	21	15	19	18
374	Negroes, whole group	169	98	84	349	2,536	12	8	49	315	11	9	12	11
	Nonworkers alone	89	90	73	348	2,402	12	7	49	306	12	9	12	11
	Workers alone	80	108	96	352	2,694	13	8	49	319	11	8	12	11
366	Sick, infirm, and bed-ridden.	52	92	109	227	2,246	31	26	115	815	25	19	34	27
371		114	99	105	329	2,647	35	23	112	793	26	18	25	23
	Average	166	97	106	297	2,519	34	24	113	802	26	18	28	24
381	Some curable, part workers, younger and more active class.	30	110	132	347	3,003	12	12	24	251	10	8	6	8
382		29	98	118	348	2,834	12	14	21	257	11	11	6	8
	Average	59	104	125	347	2,917	12	13	23	256	10	9	6	8
387	Better class, on first-section diet.	13	128	144	416	3,458	28	23	90	657	15	14	18	16
388		9	120	156	359	3,304	31	35	107	864	21	18	23	21
	Average	22	125	149	393	3,398	29	28	97	753	19	16	20	18
367	Unclassified	103	72	82	385	2,558	20	17	90	591	22	17	19	19
383		24	95	101	383	2,811	10	18	33	332	10	15	8	11
	Average	127	76	86	385	2,609	18	17	79	539	19	17	17	17
	Average of all patients [a]	.....	90	102	359	2,704	16	12	61	415	15	12	15	13
	EMPLOYEES, MALES AND FEMALES.													
365	Attendants and kitchen employees	58	121	165	495	3,961	29	28	98	757	19	15	17	16
369	Attendants, house girls, etc	13	100	141	370	3,135	72	67	245	1,864	42	32	40	37
370	....do	27	131	198	578	4,598	45	36	157	1,128	26	15	21	20
389	Officers, clerks, etc	11	140	151	422	3,522	27	28	107	785	16	16	20	18
	Average	109	123	169	493	3,968	38	35	131	988	24	17	21	20
	Average all of patients and employees [a]	.....	92	106	368	2,783	18	14	65	457	16	12	15	14

[a] In all cases the averages per man per day given in this table are not numerical averages of the results of the several studies, but are found by dividing the total quantity of each nutrient or energy by the total number of days for one man.

TABLE 31.—*Summary of results of dietary studies at the Government Hospital for the Insane and other institutions*—Continued.

Study No.	Patients.	Number of persons.	Food served.								Proportion of total served that was wasted.			
			Food eaten.				Food wasted.							
			Protein.	Fat.	Carbohydrates.	Energy.	Protein.	Fat.	Carbohydrates.	Energy.	Protein.	Fat.	Carbohydrates.	Energy.
	Studies in New York hospitals.													
	PATIENTS, MALES.													
			Gm.	*Gm.*	*Gm.*	*Cals.*	*Gm.*	*Gm.*	*Gm.*	*Cals.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
	Chronic, infirm, average 8 studies	1,069	72	65	348	2,259	4	2	14	90	5	3	4	4
	Light workers and disturbed, average 2 studies	318	73	65	346	2,255	4	2	15	94	5	3	4	4
	Restless, active, disturbed, average 2 studies	258	95	81	391	2,665	6	6	16	142	6	7	4	5
	Workers, average 10 studies	1,595	105	93	415	2,908	7	4	17	132	7	4	4	4
	Acute, recent admission, average 2 studies	70	65	86	363	2,477	7	5	22	161	9	7	6	6
	Acute and sick chronic, average 2 studies	35	66	80	364	2,432	4	2	15	94	6	2	4	4
	EMPLOYEES, MALES AND FEMALES.													
	Officers, attendants, etc., average of 6 studies	636	95	146	376	3,183	13	10	43	313	12	7	10	9
	Average of all patients and employees	.....	90	91	382	2,698	7	7	20	170	7	7	5	6
	Dietary standards for persons in health.													
	Man with moderately active muscular work	.....	125	.....	.....	3,400	.....	.....	.....	.....	.....	.....	.....	.....
	Man with light to moderate muscular work	.....	112	.....	.....	3,050	.....	.....	.....	.....	.....	.....	.....	.....
	Man with sedentary work	.....	100	.....	.....	2,700	.....	.....	.....	.....	.....	.....	.....	.....
	Woman with moderately active work	.....	100	.....	.....	2,700	.....	.....	.....	.....	.....	.....	.....	.....
	Man with very little exercise	.....	90	.....	.....	2,450	.....	.....	.....	.....	.....	.....	.....	.....
	Woman with light to moderate work	.....	90	.....	.....	2,450	.....	.....	.....	.....	.....	.....	.....	.....
	Woman with very little exercise	.....	80	.....	.....	2,200	.....	.....	.....	.....	.....	.....	.....	.....
	Proposed standard for insane hospitals.													
	Per person per day	.....	85	.....	.....	2,500	.....	.....	.....	.....	.....	.....	.....	.....
	Per man per day	.....	100	.....	.....	2,950	.....	.....	.....	.....	.....	.....	.....	.....

The studies reported in this bulletin are grouped in the table preceding according to the general conditions of the patients, since it was not feasible to make distinctions that would accord at all exactly with the amounts of muscular activity. The large majority of the patients were not especially active, though most of the studies included a few who did a small amount of light work each day, and who, by the custom of the institution, received a little extra ration. But, except in one study, the proportion of workers to nonworkers was so small and the extra ration for them was so limited as compared with the total amount fed that in calculating the results each study was treated as if the patients were all nonworkers and all received the same diet. In the study excepted—No. 374—the proportion of working patients was large, and some of them did a considerable amount of outdoor work; consequently, account was kept of the amount of extra ration served, and the results of the study have been computed for the workers and nonworkers separately, as well as for the group as a whole.

AMOUNTS OF FOOD CONSUMED AND ADEQUACY OF THE DIET.

With the ordinary individual in good health and of sound mind, the normal bodily demand for nutrients and energy depends largely upon his muscular activity; and in discussing the results of dietary studies of such persons it is customary to compare the results obtained with dietary standards for men having about the same amount of muscular work as that of the persons studied. Standards of this sort, which have been very commonly used in this country and in England, are given in Table 31.

Of course, such standards are at best tentative. They are general indications rather than exact measures of the actual physiological demands of persons in health, and their uncertainty in this respect is still greater when they are applied to persons in demented or other abnormal condition. Data concerning the actual physiological needs of insane hospital patients of different classes are as yet very inadequate; hence, it is not certain to what extent dietary standards for persons in health may be compared with the results of studies with persons not in normal mental condition. Some authorities believe that the bodily demands of the insane do not materially differ from those of persons in health with a corresponding amount of muscular activity, while others think that acutely insane patients may require more nourishment, and the chronic classes probably somewhat less than is required by normal persons. It is believed, however, that a comparison of the results of these studies with the commonly accepted standards, and with the results of studies with similar patients in other institutions, will give a tolerably clear idea of the sufficiency of the diet for the bodily needs of the patients. Such a comparison can be made with the aid of the data included in Table 31.

The ten studies of the first group in the table above comprise those with patients from middle life to old age, largely chronic insane, orderly, and quiet. The proportion of patients who did any considerable amount of work was small. The amount actually eaten in these ten studies varied from 64 grams of protein and 2,078 calories of energy per man per day to 105 grams and 2,964 calories. It is interesting to note, however, that aside from these two extreme cases, the results for the individual studies agree in the main fairly well with the average for the whole group, namely, 88 grams of protein and 2,767 calories of energy.

While the patients in these studies included a few at light work, it is doubtful if the average amount of muscular activity would be any greater than that of the average normal individual with "little exercise." The dietary standard given in the table above for men under such circumstances calls for 90 grams of protein and 2,450 calories of energy per day. If the bodily demands of these patients for nourishment were dependent upon their muscular activity, it would seem from such a comparison that they were very well nourished. Among the studies in the New York hospitals the group most nearly similar to these was that designated as "light workers and disturbed." The average consumption in studies with such patients was 73 grams of protein and 2,255 calories of energy per man per day, which was considerably below the average for these patients at the Government hospital. The patients of this class, as of others in the New York hospitals, had all the food they wanted; indeed, generally speaking, much more was served to them than they cared to eat, and there were no indications of underfeeding.

In the three studies in the second group in the table above the patients were so nearly of the same general class that it would be expected that the food consumption in one study would not differ greatly from that in another. The results as actually observed showed a range of protein from 65 to 104 grams, and of energy from 2,255 to 2,877 calories. Such differences, of 40 grams of protein and 600 calories of energy between the largest and smallest food consumption of the three, are rather surprising. It has already been stated in the account of the individual studies that the patients in study No. 376, with the lowest food consumption, appeared to be sufficiently nourished, though it can not be affirmed that they would not have been better nourished if they had eaten more. The opinion of the observer and attendants in charge, that these patients had enough, was based to some extent on the fact that the food provided was palatable and seemed satisfactory to them; furthermore, the quantities served to them were generous, so that they could have eaten more if they wished it. This was true also in the case of the patients in study No. 368, in which the consumption was also considerably smaller than that in study No. 379. It should be observed, however, that it is by no means always true that persons in normal mental health are able to adapt their food consumption to their actual bodily needs, regardless of the amount of food provided for them or their relish for it, and it may be even more generally true that persons as mentally irresponsible as were many of these patients, lack judgment in this respect. Doubtless there were some individuals who would not eat all that their bodies required, however much was set before them or however attractive or palatable the food might be.

Possibly there were some to whom the food was decidedly unattractive, so that their appetites were not stimulated. But it is difficult to believe that any large proportion failed to obtain sufficient nourishment, and the opinion that the subjects of these studies were not undernourished seemed to be justified by their appearance and general condition.

On the other hand, it could not be affirmed that the patients in study No. 379, whose average food consumption was so much larger than that in either of the other studies, were overfed. No explanation of the wide differences in the results of these three studies can be given other than that the inclinations of the patients seemed to vary. While it was the opinion of those in charge that the food consumption in each case during the time of these studies was about the same as usual, it is not certain that similar studies with the same patients at another time would not have given results showing more uniformity between the individual studies, as was the case in the preceding group.

The results in these three studies (Nos. 368, 376, and 379) are so varying that the average can hardly be taken as representative; yet it is interesting to note that such an average is close to the standard mentioned above for a man in health with very little muscular activity. Among the studies in the New York hospitals the average consumption in two with patients classed as "light workers and disturbed" was 73 grams of protein and 2,255 calories of energy per man per day, and the average in two studies with patients classed as "restless, active, and disturbed" was 95 grams of protein and 2,746 calories.

Study No. 374 was made with a group of negro patients, a large proportion of whom were workers, some doing considerable amounts of outdoor work. Considering the group as a whole, as has been done in all the other studies, the average consumption was 98 grams of protein and 2,536 calories of energy per man per day. It has seemed best in this case, however, to consider the consumption of the workers and the nonworkers separately, since there were so many of the former in the group. The results of calculations according to such a division of patients, and taking account of the extra ration for the workers, gives an average consumption of 108 grams of protein and 2,694 calories of energy for the workers and 90 grams of protein and 2,402 calories of energy per man per day for the nonworkers. The results for the nonworkers correspond quite closely to the dietary standard given above for a man with "little exercise." The results for the workers are a trifle lower in protein and noticeably lower in energy than the standard given for men with "light to moderate muscular work." The amount of work done by these patients would probably be on the average no less than that which would be represented by the standard. The results of 10 studies of patients classed as "workers" in the New York hospitals gave an average consumption of 105 grams of protein and 2,908 calories of energy per man per day, which, like the standard, was somewhat higher in energy than the results of study No. 374.

While the subjects of study No. 374 at the Government hospital did not appear to be undernourished, still it is probable that they would have been more adequately nourished if their diet had supplied a larger quantity of energy. They apparently had large appetites, and, as mentioned in the discussion of the results on page 49, the amount of food supplied to the dining room was frequently insufficient to satisfy them, so that it was necessary to send to the kitchen for more.

Studies Nos. 366 and 371 were with patients in poor health, many of them infirm and bedridden. The average amount of muscular activity of these patients was very small indeed, and a diet furnishing 97 grams of protein and 2,519 calories of energy, the average consumption per man per day for those two studies, would seem to be, at least in regard to protein, more than sufficient for their bodily needs. In the investigations in the New York hospitals the average consumption in eight studies with infirm patients was 72 grams of protein and 2,331 calories of energy per man per day, and the average of two studies with acute and sick patients was 65 grams of protein and 2,553 calories of energy.

The patients in studies Nos. 381 and 382 were younger and more active than those in the preceding groups. They were, on the whole, less demented, and with some of them there was hope of recovery. About half of the number in one study and about a third in the other were workers. The food consumption was a little larger in the former study, owing, no doubt, to the large proportion of working patients, to whom extra rations were served. The average for the two studies, 104 grams of protein and 2,917 calories of energy, approximates the standard given above for normal individuals with light to moderate muscular work, being a little lower in protein and a little higher in energy than the standard.

Studies Nos. 387 and 388 contained a large proportion of "paying patients," who were not classed as insane, but were recovering from dipsomania, the effects of fever, etc. They received the "first section's" diet, which was somewhat different from that served to the patients in other departments. They were allowed to go about the grounds at will and spent much of their time out of doors. They were all more or less active and took considerable exercise each day, but their total muscular activity was by no means equal to that of an ordinary individual at "moderately active muscular work." Their food consumption, however, averaging 125 grams of protein and 3,398 calories of energy per man per day, was equivalent to the standard quoted for such persons.

The patients in studies Nos. 367 and 383 were less easily classified than those in the other groups. Study No. 383 comprised patients of widely differing ages—from children to old men. Some were fairly quiet and orderly chronic patients, while others were practically idiots. Very few of them did any work. The group included in study No. 367 was made up of adult chronic patients, all nonworkers. The food consumption in one study was but 72 grams of protein and 2,558 calories of energy per man per day, while in the other it was 95 grams of protein and 2,811 calories of energy, the average for the two being lower than that of the ten studies in the first group in the table.

The last group in the table comprises the four studies with employees, including officers, clerks, ward and dining-room attendants, waiters, and house girls. The average amount of muscular work which they performed might perhaps be equivalent to that of persons with "light to moderate muscular work," possibly greater. The conditions in the different studies with respect to the amount of muscular work did not vary so much, however, as to account for the wide differences in food consumption observed, the quantity of protein as calculated per man per day varying from 100 grams in one study to 140 in another, and the energy from 3,135 to 4,598 calories. The average for the four studies—i. e., 123 grams of protein and 3,968 calories of energy—was the same as regards protein and higher as regards energy than the standard given above for men at "moderately active muscular" work. The indications are that these employees were very generously nourished. In the New York hospitals the average food consumption in six studies with employees, including both men and women, was 95 grams of protein and 3,183 calories of energy per man per day.

Considering the total number of studies with patients (No. 374 being taken as two studies rather than as one), the average food consumption was 90 grams of protein and 2,704 calories of energy per man per day. In a few of the studies the consumption was appreciably higher or lower than this average, but in the majority of cases the variations were not unusual, so that the average may be taken as a fair representation of the food consumption of the patients studied. Inasmuch as the amount of muscular activity of a large majority of the patients was very small, a diet furnishing such quantities of protein and energy would seem to be larger than actually necessary to satisfy their bodily needs. The standard given above for men in ordinary circumstances "with little exercise," 90 grams of protein and 2,450 calories of energy is supposed to be decidedly generous, yet as regards energy it is noticeably lower than this average consumption. The 26 studies with male patients of various classes in the different New York hospitals averaged 90 grams of protein and 2,698 calories of energy, but this included 10 studies with patients classed as workers, in which the average consumption was greatest, whereas in the studies at the Government hospital only a very small proportion of the patients were workers. As already stated, there were no indications that the subjects of the studies in the New York hospitals were not adequately nourished.

Taking all the studies at the Government hospital together, both those with patients and those with employees, the food consumed furnished on an average 92 grams of protein and 2,783 calories of energy per man per day. This is, it should be remembered, an average of studies almost entirely with men. There were some women among the attendants with whom studies were made, but their food consumption has been computed as equivalent to eight-tenths as much as that of the same number of men similarly employed, and accordingly the results are all given per man per day. There was not time to complete studies in all the wards of the institution, and as the female patients comprised only a little over a fifth of the total number, it was believed to be more important to make as many studies as possible with the male patients. Consequently nothing is known by actual study concerning the food consumption of the women patients. Their diet was in general the same in kind as that for the men, and so far as could be estimated the amounts supplied were about three-fourths as large as for the same number of men; but whether the amounts eaten were in the same proportion could not be ascertained without actual investigations.

Whether the average just stated would be a fair representation of the food consumption of men in the whole institution it is impossible to state with certainty, because there were a number of wards in which no studies were made with either patients or employees. However, from observations made in some of these wards, it was believed that in respect to both their physiological needs and their actual food consumption the persons not included in the studies did not differ materially from those studied. Inasmuch as the number of persons included in the studies was more than half of the total population of the hospital, and represented most, if not all, the different classes of employees and male patients, and furthermore since the proportion of employees to patients in the groups studied was below rather than above that of the whole institution, it seems reasonable to consider that the average of 92 grams of protein and 2,783 calories of energy per man per day would not be larger than the food consumption of at least the male population of the hospital, which, as mentioned above, comprised about three-fourths of the whole. A similar average for studies in the New York hospitals, including the 26 with male patients and 6 with employees, was 90 grams of protein and 2,698 calories of energy.

Considering both patients and employees it thus appears that as a whole the population of the Government hospital consumed almost exactly the same amounts as the average for similar groups in the New York State hospitals. From such a comparison, and judged by the commonly accepted dietary standards for men with similar amounts of muscular activity, it is evident that the population of the Government hospital received a diet generous as regards the amounts of protein and energy supplied. It seems fair to conclude, therefore, that the diet was certainly adequate for their needs.

AMOUNTS OF FOOD WASTED AND ECONOMY IN UTILIZATION OF FOOD.

Of the total food brought into the hospital, by no means the whole is eaten. A portion of some food materials consists of inedible substance, such as the bone of meat, the shells of eggs, the skins and seeds of vegetables, and the like, which is commonly designated as refuse, and is taken into account in considering the composition of the food and computing the quantity of nutrients it contains. But in addition to this, more or less edible material is lost in various ways. There are losses in the storeroom due to handling and in some cases to deterioration and decay. For instance, in cutting up large pieces of meat, like a side of mutton or a quarter of beef, into smaller cuts, edible material is often lost in trimming out bone and surplus fat. There are losses in the kitchen in preparing and cooking foods. In paring vegetables, as potatoes or squash, for example, it is not easy to cut off the skin without taking also more or less of the nutritive material beneath the skin, the amount thus lost depending of course upon the character and condition of the vegetables and the care observed in paring. In transferring food from the kettles and pans in which it is cooked to the dishes in which it is carried to the table, more or less adheres to the cooking utensils and is thus lost. Of the food which is sent to the dining room not all is actually served, the amounts provided being commonly larger than are needed to feed the persons in the dining room. More or less of the "left-over" material is returned to the kitchen and used in preparation of "made dishes" to be served later, but a portion of it is wasted. Finally, a portion of the food which is served at the tables is frequently left uneaten on the plates, and as such residue is of course unfit for serving again, it is utilized only as food for swine.

In short, it is practically impossible to store, prepare, and serve food without more or less loss of edible material, the amount lost depending upon the conveniences for storing and handling, the care and intelligence of the persons who do the work, and the extent to which food served is actually eaten. These losses, whether inevitable or due to carelessness, are designated as "waste," as distinguished from refuse, a term which is explained above. As explained on a later page, some waste is unavoidable, and a reasonable amount is not incompatible with good management.

For a comprehensive discussion of the utilization of food it would be necessary to consider the amounts purchased by the hospital and brought into the storeroom, the amounts supplied from the storeroom to the different kitchens, the amounts lost in the kitchens—i. e., the kitchen waste incident to the preparation of food, and the amounts lost in the dining rooms, i. e., table waste due either to failure to return "left-over" edible food to the kitchen for future use or to excessive serving and consequent waste on the plates.

Just how large a proportion of the total food of the Government hospital was wasted it is not possible to determine from these investigations. Exact statistics regarding the quantities of food purchased and brought into the storeroom were not conveniently available; hence, the loss due to shrinkage, deterioration, etc., could not be ascertained. Regarding the losses in other ways enumerated above, however, the data collected in the investigations afford considerable information, and these data are summarized and discussed in the following pages.

DINING-ROOM OR TABLE WASTE.

The figures of the dietary studies showing the total amounts of food served, eaten, and wasted in the dining room, given in detail in Table 35 of the Appendix, are here summarized in the table which follows.

TABLE 32.—*Summary of data regarding total amounts of food provided, returned, eaten, and wasted.*

Dietary study.	Total food provided.		Food returned.			Food served.				Proportion of food provided.	
			Total.		Proportion of food provided.	Food eaten.		Food wasted.		Eaten.	Wasted.
	Kilos.	*Pounds.*	*Kilos.*	*Lbs.*	*Per ct.*	*Kilos.*	*Pounds.*	*Kilos*	*Pounds.*	*P. ct.*	*P. ct.*
No. 364	5,910.3	13,002.7	32.3	71.1	0.5	5,270.3	11,594.7	607.7	1,336.9	89.2	10.3
No. 365	1,266.2	2,785.6	167.3	368.1	13.2	889.8	1,957.6	209.2	460.2	70.3	16.5
No. 366	805.3	1,771.7	10.7	23.5	1.3	610.1	1,342.2	184.5	405.9	75.7	23.0
No. 367	1,151.7	2,533.7	65.2	143.4	5.7	834.3	1,835.5	252.2	551.8	72.4	21.9
No. 368	331.4	729.1	9.5	20.9	2.9	236.5	520.3	85.4	187.9	71.4	25.7
No. 369	306.0	673.2	20.7	45.5	6.8	159.9	351.8	125.5	276.1	52.2	41.0
No. 370	628.9	1,383.6	32.1	70.6	5.1	453.9	998.6	142.9	314.4	72.2	22.7
No. 371	2,361.9	5,196.2	22.7	49.9	1.0	1,850.0	4,070.0	489.2	1,076.2	78.3	20.7
No. 372	979.0	2,153.8	......	......	....	719.4	1,582.7	259.6	571.1	73.5	26.5
No. 373	1,177.2	2,589.8	......	......	....	989.5	2,176.9	187.7	412.9	84.0	16.0
No. 374	1,925.6	4,236.3	23.6	51.9	1.2	1,629.7	3,585.3	272.4	599.3	84.6	14.2
No. 375	494.9	1,088.8	17.1	37.6	3.5	331.3	728.9	146.5	322.3	66.9	29.6
No. 376	320.8	705.8	2.7	5.9	.8	218.0	479.6	100.0	220.0	68.0	31.2
No. 377	470.4	1,034.9	......	......	....	364.1	801.0	106.3	233.9	77.4	22.6
No. 378	298.1	655.8	23.5	51.7	7.9	216.3	475.9	58.4	128.5	72.6	19.5
No. 379	499.5	1,098.9	25.4	55.9	5.1	412.4	907.3	61.6	135.5	82.6	12.3
No. 380	517.7	1,138.9	62.7	137.9	12.1	383.0	842.6	72.0	158.4	74.0	13.9
No. 381	391.1	860.4	33.1	72.8	8.5	330.5	727.1	27.5	60.5	84.5	7.0
No. 382	391.1	860.4	43.7	96.1	11.2	322.8	710.2	24.6	54.1	82.5	6.3
No. 383	335.8	738.8	50.8	111.8	15.1	262.3	577.1	22.7	49.9	78.1	6.8
No. 384	429.0	943.8	89.2	196.2	20.8	298.7	657.1	41.1	90.4	69.6	9.6
No. 385	412.7	907.9	45.4	99.9	11.0	348.3	766.3	19.1	42.0	84.4	4.6
No. 386	409.8	901.6	40.3	88.7	9.8	343.7	756.1	25.9	57.0	83.9	6.3
No. 387	258.8	569.4	30.2	66.4	11.7	185.3	407.7	43.2	95.0	71.6	16.7
No. 388	210.0	462.0	35.3	77.7	16.8	137.3	302.1	37.4	82.3	65.4	17.8
No. 389	263.0	578.6	24.2	53.2	9.2	197.1	433.6	41.7	91.7	74.9	15.9
Average of 26 studies	867.2	1,907.8	34.9	76.8	4.0	692.1	1,522.6	140.2	308.4	79.8	16.2

The first column, headed "food provided," shows in the case of each study the total quantity of food sent from the kitchen where it was prepared to the dining room or ward where it was to be used. The second column, "food returned," shows how much of the food left after serving was sent back to the kitchen to be used again in "made dishes" or otherwise disposed of. The latter quantities therefore represent an excess of food provided over what was needed to serve the persons included in the study; but they do not show how much of an excess there was in each case, because some food left over from serving was not returned to the kitchen. When the amount was small, it was commonly thrown into the receptacles for the material left upon the plates.

The data in the table show a wide variation in the quantities of food returned in different studies. In some cases there was none, but in several 10 per cent or more, and in one case over 20 per cent of the total amount of food provided was returned to the kitchen, even after the patients had been generously served. Averaging the data for all the studies, the quantity of food returned was equivalent to about 4 per cent of the total food provided.

It is not to be inferred that in those studies in which no food was returned the amount provided was not in excess of what was necessary to serve the persons fed. The matter of returning food was left entirely to the discretion of the persons in charge of the serving, who appeared to follow no regular system and most of whom had no uniform custom. Meat and potatoes were quite generally returned, but in the case of the other materials, some of the attendants were careful to return whatever was left over; some returned only the larger quantities; and some returned none, but added all that was left from serving to what was left upon the plates after the meal. In the studies for which there is no record of food returned, therefore, the excess of food provided over food served may have been added to the waste in the dining room. It was not possible to get exact statistics in each study concerning the amounts actually left after serving, though it was possible to take account of whatever was actually returned to the kitchen.

While part of this excess material was utilized again, part of it was wasted after it was returned to the kitchen; that is, though wholesome and fit for use on the table, it was given to the pigs. Just what proportion was utilized it was not found practicable to determine by actual weighings, but from observation and inquiry it was learned that meat and potatoes thus returned to the kitchen were generally utilized, the former sometimes for serving cold, and both sometimes for hash. Bread returned was also used for pudding, but little or no provision was made for saving most other "left-over" materials and preparing them for serving again in other forms.

The term "food served" as used in Table 32 and in the corresponding table of the Appendix has reference to the portion of the "food provided" that was disposed of in the dining room, including both the amounts of food which were actually eaten and those which were wasted. The total quantity thus designated is therefore equal to the difference between that provided and that returned. As a matter of fact, there is an inaccuracy in the account of "food served" which, though of minor importance, should be mentioned, namely, that part of what is designated as "food wasted," and accordingly enters into the account of food served, had never been served and should have been returned to the kitchen.

In gathering the data regarding food wasted at the end of each meal the different kinds of food in the rejected material were separated and the quantity of each was determined. In most cases the larger part of this material consisted of what was left upon the plates, but to some extent it comprised also food that had not been served; because, as mentioned above, when the amount of food left in the serving dishes was not large it was frequently added to what was left upon the plates instead of being returned to the kitchen for future use, and indeed in some cases all of such "left-over" material, except meat and potatoes, was thus disposed of. Inasmuch as under the circumstances it was impracticable to have such material kept separate from material actually left upon the plates, it was necessary to record the whole as "food wasted." It would seem therefore more appropriate to consider the whole as "dining-room" rather than as "table" waste.

The amount of food wasted in the dining room in some of the studies was relatively small, while in others it formed a considerable proportion of the total food provided, the range being from 5 per cent in study No. 385 with patients, to 41 per cent in study No. 369 with employees. In 16 of the studies the proportion was above 15 per cent, in one it was 14 per cent, and in the remainder it was between 5 and 12 per cent. On an average for the studies with patients the amount of food thus wasted was 16 per cent of the total amount provided; for those with employees it was 24 per cent; considering all the studies together it was 16 per cent.

It would be still more interesting if possible to compare the amounts wasted in the dining room with those served, because such comparison would afford a better idea of how much food was served in excess of the amounts actually eaten, the latter being, of course, the difference between the amounts served and those wasted. The difficulty in making such a comparison as just explained was that the dining-room waste included some material that was never served.

Such considerations of the total amounts of food eaten and wasted are interesting, but the quantities of nutrients and energy per man per day are of more significance. With regard to food eaten and wasted these data form part of the account of the different studies on pages 19 to 71 and are summarized in Table 31. The quantities of nutrients and energy in the food returned were also calculated, although the results of the computations are not given in detail. It was explained above that a part of this returned material, chiefly the meat, bread, and potatoes was utilized again and the remainder wasted, and the computations of the quantities of nutrients and energy in the returned material that was wasted were made on this basis.

Strictly speaking, this is not a part of the table waste, which, as explained above, is material wasted at the plates; nor is it a part of the kitchen waste, which is loss in the preparation and cooking of food. Since it was actually wasted in the kitchen it might be more logical to consider it along with the latter, but for convenience it is here discussed with dining-room waste. Another reason for considering it here is that part of the material designated in the tables as "food wasted" should really have been returned to the kitchen.

The quantities of nutrients and energy per man per day in the food consumed and wasted are summarized in the following table. The data here included are average values derived from the results of all the dietary studies, and probably represent the conditions for the whole institution:

Table 33.—*Summary of data regarding nutrients and energy per man per day in food consumed and wasted.*

	Protein.	Fat.	Carbohydrates.	Energy.
	Grams.	*Grams.*	*Grams.*	*Calories.*
In food actually eaten	92	107	368	2,792
In dining-room waste	18	14	65	457
In food returned:				
Used again	5	4	11	100
Wasted	1	2	8	54
Total in food provided	116	127	452	3,403

By referring to Table 31 it will be observed that the table waste ranged from 5 grams of protein and 146 calories of energy per man per day in study No. 385 to 72 grams of protein and 1,864 calories of energy in study No. 386. The average for the total number of persons included in the studies, given in the table above, was 18 grams of protein and 457 calories of energy. If to this is added the portion of returned food that was eventually wasted, the total amount of waste was sufficient to supply on an average 19 grams of protein and 511 calories of energy per man per day.

With regard to the food returned it may be observed that, while the quantity that was eventually wasted was relatively large in comparison with the total returned, in actual nutritive value it was of much less importance than that used again; for, as seen from the table above, the latter contained 83 per cent of all the protein and 65 per cent of all the energy of the food returned.

Considering all the data in the table it would appear that the food provided, that is, sent from the kitchen to the dining room, was sufficient to supply 116 grams of protein and 3,403 calories of energy per man per day.

KITCHEN WASTE.

The data recorded in the investigations did not include an account of the total amount of food brought into each kitchen. Hence, it is not possible to determine the total amount of kitchen waste. It is possible, however, to make a general estimate on the basis of the quantities of nutrients and energy per man per day sent to the kitchen.

As explained on page 71, statistics were obtained regarding the amounts of food issued from the storeroom to all the kitchens of the institution for a year, and the quantities of nutrients and energy per man per day were computed on the basis of the average population for the year. These results are given in Table 30 on page 72. In Table 33 are summarized the results of the investigations regarding the quantities of nutrients and energy per man per day in the food sent from the kitchens to the dining rooms. There is therefore an opportunity to compare average figures for food received in the kitchens from the storeroom and food sent from the kitchens to the dining rooms. The difference should represent loss incident to preparation and cooking. Such a comparison is given in the following table:

Table 34.—*Summary of data regarding nutrients and energy in kitchen waste.*

	Protein.	Fat.	Carbohydrates.	Energy.
	Grams.	*Grams.*	*Grams.*	*Calories.*
In food issued from storeroom	127	172	517	4,107
In food supplied to dining rooms	116	127	452	3,403
In kitchen waste	11	45	65	704

Strictly speaking, such a comparison is not warranted for two reasons. In the first place, as already explained, the average consumption for the whole population can not be determined from the investigations reported, because these do not include any studies with women patients; hence, nothing certain is known regarding the consumption of the women as compared with that of the men. In making the computations regarding food issued it was assumed that the food consumption of a woman would be eight-tenths that of a man. In the second place, the statistics obtained for the food issued from the storeroom to the kitchens of the whole institution were not for the same period as that in which the studies were made, but for the year just preceding. However, so far as could be ascertained from a cursory examination of the accounts for the period of the studies, the supplies for the two years differed so little in character and amount that the estimate of the quantities of nutrients and energy per man per day in the food for the preceding year would at least give some indication of what they might be during the year in which the studies were made. With regard to the assumption that the average of the results of the studies with regard to food eaten, wasted, etc., may be taken as representative of the whole population, it may be stated that the number of persons included in the studies was more than half of the total population, and indeed considerably more if the number of women be considered as equivalent to eight-tenths the same number of men. The larger part of the population, nearly three-fourths, consisted of men, and the different classes of male patients were believed to be fairly well represented in the studies made. The groups of employees included in the studies were also considered representative. It therefore seems reasonably fair to make the comparison as given in the table above.

From the data thus compared it would appear that the amount of food lost in the kitchen in connection with the preparation and cooking of food and transferring it to dishes to be carried to the dining room was sufficient to supply 11 grams of protein and 704 calories of energy per man per day.

TOTAL DINING-ROOM AND KITCHEN WASTE.

Combining the data in Tables 33 and 34 above regarding waste of returned food and dining-room and kitchen wastes would indicate that the total loss of food in these ways was sufficient to furnish on an average 30 grams of protein and 1,215 calories of energy per man per day. Similar computations from the results for food supplied and food consumed in the studies made in the New York hospitals[a] showed a loss sufficient to supply 40 grams of protein and 1,143 calories of energy per man per day. In other words, in respect to actual nutritive value, the loss in the Government hospital was about 25 per cent, and in the New York hospitals about 30 per cent of that of the total food. In institutions of this sort some loss of food is inevitable, and what might perhaps reasonably be considered a normal amount may be an appreciable proportion of the total provided. Even in private families and in boarding houses, not all the food purchased is actually eaten. In upwards of 500 dietary studies of such groups in different parts of this country, the waste of food among private families has ranged from practically none, where the diet was extremely simple, to as high with a more varied diet as 8 or 10 per cent of the total purchased; and in boarding houses and students' clubs, even where economy was desired and sought, it has been not uncommonly 10, and in some exceptional cases even 20 per cent. In larger establishments, such as hospitals for the insane, economy in dietary management is a more difficult matter than in ordinary families or boarding houses, and even with the most careful management the losses may easily be larger.

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[a] N. Y. State Com. Lunacy Rpt. 13 (1900–1901), p. 116.

PREVENTION OF WASTE.

Just what proportion of the waste of food in the Government hospital could have been prevented can be determined only by investigation and experiment; but from a consideration and comparison of the statistics for the individual studies it would appear that in many cases the amount was decidedly larger than would seem necessary. That some of the loss could have been prevented is evident from a consideration of the way in which losses may occur.

The food wasted in the dining room consisted in part of material left in the serving dishes, but mostly of what was left uneaten upon the plates. The waste of food that had not been served was due to failure on the part of those in charge of the dining rooms to return such material to the kitchen, owing either to carelessness or lack of instruction in the matter of preserving "left-over" material for future use. It would seem that this waste could be easily prevented, either by more care on the part of those in charge of the serving, or by reducing the quantity sent to the dining room to more nearly that which would be required to feed the patients.

The waste upon the plates is less easily prevented. Food may be left uneaten for various reasons. There may be a natural lack of appetite with individuals; or the food may be unsuited to their tastes. Furthermore, because improperly cooked or flavored or unattractively served, it may fail to stimulate the appetite; or it may be unfamiliar or too familiar in appearance or taste to be palatable. On the other hand, the amount served to each individual may be in excess of his needs or desires. In one study, for instance, breakfast foods, meat stews, and leguminous soups were not relished, and from a fourth to a third of the oatmeal and nearly half of the hominy served were wasted. Obviously the amounts served in this case were excessive, and a reduction in quantities served would have materially reduced the waste. This could have been done without affecting the adequacy of the diet, because in spite of the large waste the amounts of nutrients and energy of the food actually eaten were believed to be sufficient for the needs of the subjects.

Frequently one of the principal causes of table waste is unsatisfactory preparation of food, including cooking, flavoring, garnishing, etc. When food is well cooked and tastefully served, and so attractive to the eye as well as pleasing to the palate, it is much more apt to be economically eaten than when the preparation and serving are less carefully done. A considerable part of the pecuniary, and, indeed, the hygienic, economy of nutrition depends upon the methods of handling the food in the kitchen and dining room. This is a matter to which naturally much more attention can be given in a small family than is possible in a large institution, but even in the latter it is worthy of more consideration than is sometimes given.

So far as evidence was obtained in the course of these investigations, however, the rejection of food could be attributed less to any failure in the matter of preparation than to other causes. In general a close supervision was kept over the work of preparing food, the cooking was well done, and seasoning or flavoring was as carefully attended to as was possible under the circumstances. This has been particularly mentioned in the discussion of study No. 364, on page 23. It is believed that in this respect the conditions at this hospital would compare most favorably with those in similar institutions elsewhere.

It is true, however, that the food may be well prepared and attractively served and still be rejected in considerable proportion unless it has a familiar appearance and taste, because people generally prefer the kind of food to which they have been accustomed; and frequently, especially when ordinarily they have been used to little variety, they do not at first relish what is novel to them. Such considerations suggest that for the most successful and economical feeding of persons in institutions it is essential to take account of their previously acquired food habits. Obviously, however, with a large number of individuals of widely varying habits, it would be difficult to prepare a satisfactory diet that would in all respects be familiar to each one. But it is easy to exclude materials which are more or less unfamiliar or distasteful to many of them, and which would very likely be left uneaten. Failure to do this may have been the reason for the large amount of some of the foods rejected in these studies; for instance, wheat breakfast foods were left uneaten in large proportions in nearly every study, though oatmeal was evidently relished.

On the other hand, monotony in the diet is especially to be avoided, as this has a decided tendency to diminish the relish for food. This effect has been observed to follow where there is a uniformity in the rotation of the menu—that is, where the same menu is used on the same day in successive weeks, as is frequently the case in institutions. Under such circumstances a large number of persons associate the days of the week with the kind of food that will be served, and the pleasurable sensation that acts as a sort of stimulation to appetite when the nature of the meal is more or less of a surprise is lost. Under such circumstances the amount eaten is generally smaller. These conditions were present to an appreciable extent in some of the studies here reported.

In addition to such conditions which fail to stimulate and may even take away desire for food, there may be a natural variation in appetite from day to day, which may result from differences in either physical or mental conditions, and this would affect the quantity of food consumed. Under such circumstances, where the plan is to provide enough for all when conditions of appetite are normal, there would, of course, be more or less waste which it would be difficult to avoid. It could be materially reduced, however, by providing amounts for serving which are based upon the observed consumption through considerable periods.

Waste can not be entirely avoided; more or less is inevitable; but it can be kept at a minimum. It is possible, even in large institutions, to provide for the utilization of food so that the losses shall be small. This can be accomplished by a better understanding of the nutritive values of different foods and of the demands of people for nourishment, and by improvements in the methods of preparing, cooking, and serving the food. Under such conditions it would be possible to provide a palatable, attractive, and nutritious diet at minimum cost. That reduction of cost was possible was demonstrated in the course of the studies here reported. From time to time opportunities for improvement were pointed out to the late Dr. Richardson, then superintendent, and were promptly acted upon by him; and he stated that, in his opinion, as a result of the investigations, the cost of the food during the last six months of the year was lower than for any corresponding period during his connection with the institution, and at the same time the general character of the diet was not changed nor was the standard lowered in any way.

APPENDIX.

The statistical details of the investigations, from which the data discussed in the preceding section of the bulletin have been derived, are given here. These include the records of the kinds and amounts of food used in the dietary studies, the account of the food issued from the storeroom for a year, the table of percentage composition, and data for the computation of the composition of cooked foods.

STATISTICS OF FOOD USED.

The first column in Table 35 below, headed "Food provided," shows the amount of each kind of food sent from the kitchen to the dining room. The second column, "Food returned," shows the amount of each food left after serving in the dining room that was returned to the kitchen. The third column shows the amount of each food that was actually eaten, and the next three columns the quantities of protein, fat, and carbohydrates it contained. The seventh column shows the amount of food wasted in the dining room, including both that left at the plates and that left in the serving dishes and not returned to the kitchen. It was not found practicable to obtain separate accounts of actual table waste and material that should have been returned but was added to the table waste. The next three columns show the quantities of nutrients in the food wasted in the dining room. The final column shows the percentage of "Food provided" that was wasted in the dining room.

The figures in parentheses after the name of each food are the same as given for the same material in the column headed "Reference number" in Table 37 beyond, and indicate the percentage composition used in calculating the quantities of nutrients in the amount of food.

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies.*

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 364.											
ANIMAL FOOD.											
Beef and mutton:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Boiled (7)	66,225		60,669	14,621	21,720		5,556	1,339	1,989		8
Boiled (6)	12,474		10,206	3,246	2,888		2,268	721	642		18
Corned (30)	64,071	2,495	55,679	16,648	28,007		5,897	1,763	2,966		9
Liver (11)	24,721		22,453	5,838	3,480	449	2,268	590	352	45	9
Roast (16)	35,040		29,257	7,636	10,708		5,783	1,509	2,117		16
Sausage, Bologna (35)	9,866		8,278	1,548	1,457	25	1,588	297	279	5	16
Steak (24)	49,896		46,381	14,007	9,369		3,515	1,062	710		7
Mutton roast (40)	2,948		2,948	737	666						
Total	265,241	2,495	235,871	64,281	78,295	474	26,875	7,281	9,055	50	10
Pork, lard, etc.:											
Bacon (50)	15,422		15,422	3,069	9,454						
Ham (51)	454		454	101	151						
Sausage, Frankfort (63)	9,299		8,505	1,667	1,582	94	794	155	148	9	9
Sausage, pork (60)	39,236		39,236	8,318	26,759	706					
Shoulder (56)	75,637		68,720	15,530	27,831		6,917	1,563	2,801		9
Total	140,048		132,337	28,685	65,777	800	7,711	1,718	2,949	9	6
Fish:											
Cod, baked (68)	55,793		44,453	5,734	89		11,340	1,463	23		20
Mackerel, salt (78)	36,174		29,824	6,591	10,081		6,350	1,403	2,146		18
Total	91,967		74,277	12,325	10,170		17,690	2,866	2,169		19
Butter (88)	167,378		167,378	1,674	142,271						
Cheese (89)	55,339		54,432	14,098	18,344	1,306	907	235	306	22	2
Evaporated cream (90)	45,814		45,814	4,398	4,261	5,131					
Total animal food	765,787	2,495	710,109	125,461	319,118	7,711	53,183	12,100	14,479	81	7
VEGETABLE FOOD.											
Cereals:											
Bread (133)	1,345,831		1,204,081	110,775	15,653	639,367	141,750	13,041	1,843	75,269	11
Cake (137)	38,783		38,783	2,443	1,784	22,067					

Crackers, soda (131)	98, 204	....	94, 916	9, 302	8, 637	69, 384	3, 288	322	299	2, 404	3
Gingerbread, etc. (141)	82, 101	....	82, 101	4, 762	7, 389	52, 134	....	....	....	....	....
Hominy (92)	53, 184	....	28, 236	508	452	4, 715	21, 948	449	399	4, 166	47
Oatmeal (104)	212, 625	....	165, 791	4, 642	1, 989	18, 569	46, 834	1, 311	562	5, 245	22
Total	1, 830, 728	....	1, 613, 908	132, 432	35, 904	806, 236	216, 820	15, 123	3, 103	87, 084	12
Sugars, starches, etc.:											
Pudding sauce (145)	25, 742	....	25, 742	515	4, 659	19, 306	....	....	....	....	....
Sugar (146)	205, 027	....	205, 027	....	....	205, 027	....	....	....	....	....
Total	230, 769	....	230, 769	515	4, 659	224, 333	....	....	....	....	....
Vegetables:											
Beans, baked (148)	57, 834	....	45, 133	3, 972	4, 423	12, 773	12, 701	1, 118	1, 245	3, 594	22
Beans, baked (147)	75, 298	....	70, 762	6, 156	5, 095	18, 186	4, 536	395	327	1, 166	6
Beets (157)	68, 833	....	64, 751	1, 166	65	6, 864	4, 082	73	4	433	6
Cabbage, boiled (165)	253, 902	....	232, 583	4, 119	698	15, 350	21, 319	405	64	1, 406	8
Corn, stewed (177)	62, 937	....	62, 937	1, 762	755	10, 385	....	....	....	....	....
Eggplant (180)	39, 237	....	37, 536	2, 402	9, 196	12, 199	1, 701	109	417	553	4
Potatoes, steamed (207)	409, 261	13, 041	353, 128	6, 709	353	52, 969	43, 092	819	43	6, 463	11
Soup, bean (239)	533, 773	....	449, 744	9, 445	900	30, 133	84, 029	1, 765	168	5, 630	16
Soup, vegetable (250)	245, 397	....	214, 099	1, 285	....	22, 052	31, 298	188	....	3, 223	13
Soup, vegetable (251)	255, 943	....	211, 088	1, 205	....	9, 643	14, 855	71	....	594	6
Slaw (236)	49, 441	....	36, 174	579	108	2, 026	13, 267	212	40	743	27
Tomatoes, stewed (263)	63, 646	....	58, 854	1, 059	235	13, 065	4, 762	86	19	1, 057	8
Tomatoes, stewed (264)	5, 897	....	4, 536	82	18	1, 302	1, 361	25	5	391	2
Total	2, 121, 369	13, 041	1, 871, 325	40, 241	21, 846	206, 947	237, 003	5, 269	2, 332	25, 253	11
Fruits, etc.:											
Apples, baked (275)	197, 769	....	164, 203	493	493	26, 273	33, 566	101	101	5, 370	17
Jelly, apple (292)	86, 637	6, 577	73, 370	220	....	51, 359	6, 690	20	....	4, 683	8
Sauce, prune (287)	55, 906	....	51, 370	360	....	19, 058	4, 536	32	....	1, 683	8
Sauce, prune (288)	49, 783	....	42, 525	340	....	18, 286	7, 258	58	....	3, 121	15
Total	390, 095	6, 577	331, 468	1, 413	493	114, 976	52, 050	211	101	14, 857	13
Total vegetable food	4, 572, 961	19, 618	4, 047, 470	174, 601	62, 902	1, 352, 492	505, 873	20, 603	5, 536	127, 194	11
MISCELLANEOUS FOOD.											
Pudding, bread (353)	103, 648	....	97, 524	2, 536	2, 243	21, 553	6, 124	159	141	1, 353	6
Pudding, steamed (366)	49, 896	....	49, 896	2, 445	4, 441	27, 044	....	....	....	....	....
Rhubarb pie (350)	122, 245	10, 206	112, 039	3, 137	12, 997	30, 250	....	....	....	....	....
Stew, beef (315)	102, 740	....	82, 215	8, 304	6, 988	6, 659	20, 525	2, 073	1, 745	1, 662	20
Stew, beef (314)	94, 122	....	78, 473	7, 533	6, 749	2, 668	15, 649	1, 502	1, 346	532	17
Stew, beef (313)	98, 884	....	92, 534	9, 068	8, 050	7, 403	6, 350	622	552	508	6
Total	571, 535	10, 206	512, 681	33, 023	41, 468	95, 577	48, 648	4, 356	3, 784	4, 055	9
Total food	5, 910, 283	32, 319	5, 270, 260	333, 085	423, 488	1, 455, 780	607, 701	37, 059	23, 799	131, 330	10

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 365.											
ANIMAL FOOD.											
Beef:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Dried, stewed (34)	2,041		794	176	159		1,247	277	249		61
Liver (10)	4,763	1,361	3,005	859	688	859	397	114	91	114	8
Steak (25)	19,390	3,515	12,360	3,102	2,855		3,515	882	812		18
Corned (29)	12,475	5,330	5,217	1,633	2,734		1,928	603	1,010		15
Bologna (35)	5,103	1,021	3,742	700	659	11	340	64	60	1	7
Boiled (4)	6,577	1,361	4,479	1,380	1,689		737	227	278		11
Total	50,349	12,588	29,597	7,850	8,784	870	8,164	2,167	2,500	115	16
Pork:											
Ham, fried (53)	5,557	907	3,856	817	1,134		794	168	233		14
Pork, baked (45)	14,062	1,474	11,964	2,620	3,170		624	137	165		4
Gravy (64)	5,103		5,103	46	1,812	270					
Gravy (65)	3,969		3,629	40	1,038	167	340	4	97	16	9
Sausage (59)	7,485	2,779	4,593	753	2,255	55	113	19	55	1	2
Shoulder (56)	8,391	680	7,144	1,615	2,893		567	128	230		7
Bacon (51)	4,252	1,701	2,154	491	1,178		397	91	217		9
Chops (42)	10,206		9,866	2,397	2,782	1,204	340	83	96	41	3
Total	59,025	7,541	48,309	8,779	16,262	1,696	3,175	630	1,093	58	5
Fish:											
Mackerel, salt (79)	7,144		6,350	1,130	1,207		794	141	151		11
Cod, stuffed (70)	12,473	4,762	7,598	1,049	2,059	304	113	16	306	5	1
Cod, scalloped (69)	12,814		5,046	999	91	409	7,768	1,538	140	629	61
Total	32,431	4,762	18,994	3,178	3,357	713	8,675	1,695	597	634	27
Eggs:											
Raw (83)	1,304		1,304	171	121						
Fried (86)	6,690		5,613	763	1,106		1,077	146	212		16
Total	7,994		6,917	934	1,227		1,077	146	212		13
Butter (88)	23,418	9,526	13,892	139	11,807						
Cheese (89)	8,052	454	7,598	1,968	2,561	182					
Milk (91)	192,439	3,402	189,037	6,238	7,561	9,452					
Total animal food	373,708	38,273	314,344	29,086	51,559	12,913	21,091	4,638	4,402	807	6

VEGETABLE FOOD.										
Cereals:										
Bread (133)	160,971	58,854	81,818	7,527	1,064	43,445	20,299	1,868	264	10,779	13
Crackers (134)	2,154	227	1,927	189	175	1,409	....	....	....	....	....
Wheat breakfast food (127)	38,330	....	16,330	294	65	2,237	22,000	396	88	3,014	57
Wheat breakfast food (128)	12,474	....	4,082	102	16	637	8,392	210	34	1,309	67
Cake, jelly (138)	5,443	....	4,422	279	398	2,799	1,021	64	92	646	19
Corn bread (130)	10,773	....	8,505	434	1,182	3,062	2,268	116	315	816	21
Oatmeal (112)	23,757	....	15,592	452	231	1,871	8,165	237	122	980	34
Gingerbread (141)	3,742	....	2,608	151	235	1,656	1,134	66	102	720	30
Cereal, mixed (95)	8,505	....	6,691	154	40	790	1,814	42	11	214	21
Mush (97)	7,257	....	3,742	49	15	554	3,515	46	14	520	48
Rice, boiled (123)	24,493	11,226	11,056	111	....	1,050	2,211	22	....	210	17
Total	297,899	70,307	156,773	9,742	3,424	59,510	70,819	3,067	1,042	19,208	24
Sugar (146)	65,885	8,505	57,380	....	....	57,380	....	....	....	....	....
Vegetables:											
Beans, baked (152)	19,164	....	10,319	805	815	2,394	8,845	690	699	2,052	46
Potatoes, fried (222)	40,258	....	18,655	466	1,548	4,011	21,603	540	1,793	4,645	54
Potatoes, mashed and creamed (229)	27,897	3,856	13,665	369	492	2,733	10,376	280	374	2,075	37
Potatoes, boiled (211)	32,546	17,577	14,515	319	....	2,743	454	10	....	86	1
Potatoes, hashed (223)	7,030	1,134	4,649	121	....	1,199	1,247	32	....	322	18
Potato cakes (231)	9,072	....	6,577	132	362	1,151	2,495	50	137	437	27
Tomatoes, stewed (267)	9,412	4,139	4,593	64	64	464	680	10	10	69	7
Peas (188)	10,546	7,938	2,608	89	44	303	....	....	....	....	....
Cabbage, boiled (168)	53,865	....	32,376	680	486	2,169	21,489	451	322	1,440	40
Corn, stewed (178)	34,133	9,072	20,071	582	763	4,215	4,990	145	190	1,048	15
Soup, vegetable (252)	33,794	....	27,670	249	....	1,826	6,124	55	....	401	18
Sweet potatoes, baked (257)	15,422	....	14,118	339	833	5,068	1,304	31	77	468	8
Beets, boiled (156)	7,995	....	3,686	63	41	627	4,309	73	47	733	54
Total	301,134	43,716	173,502	4,278	5,448	28,903	83,916	2,367	3,649	13,779	28
Fruits, etc.:											
Apples (271)	17,351	3,856	13,495	40	40	1,457	....	....	....	....	....
Apples, fried (277)	5,386	....	4,479	188	36	1,165	907	38	7	236	17
Sauce, apple (301)	28,917	2,608	25,515	102	102	7,935	794	3	3	247	3
Grapes (281)	12,928	....	9,639	96	116	1,388	3,289	33	39	474	25
Pears, stewed (285)	17,237	....	17,237	69	69	4,016	....	....	....	....	....
Total	81,819	6,464	70,365	495	363	15,961	4,990	74	49	957	6
Total vegetable food	746,737	128,992	458,020	14,515	9,235	161,754	159,725	5,508	4,740	33,944	21
MISCELLANEOUS FOOD.											
Gravy (329)	3,289	....	3,289	46	273	181	....	....	....	....	....
Pie, custard (346)	454	....	454	19	29	118	....	....	....	....	....
Pie, apple (344)	11,567	....	11,567	220	775	3,354	....	....	....	....	....
Pudding, cottage (359)	6,124	....	5,217	350	579	3,130	907	61	101	544	15

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 365—Continued.											
MISCELLANEOUS FOOD—continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Pudding, chocolate (355)	11,056	....	5,783	168	335	1,423	5,273	153	306	1,297	48
Pudding, floating island (361)	13,381	....	10,773	506	474	2,413	2,608	123	115	584	19
Custard, plain (336)	8,165	....	5,840	327	292	975	2,325	130	116	388	28
Custard, chocolate (337)	13,041	....	10,773	485	528	1,756	2,268	102	111	370	17
Sauce, pudding (370)	4,876	....	4,876	44	229	683	....	....	....	....	....
Sauce, pudding (371)	3,629	....	3,175	159	121	518	454	23	17	74	13
Macaroni and tomato (334)	15,763	....	12,361	433	62	2,373	3,402	119	17	655	22
Lemon ice (341)	5,557	....	5,557	44	....	4,579	....	....	....	....	....
Hash cakes (308)	7,485	....	3,289	414	332	339	4,196	529	424	432	56
Beef pie (311)	22,453	....	17,123	1,387	3,699	2,842	5,330	432	1,151	885	24
Gravy, beef (330)	3,969	....	3,969	....	....	44	....	....	....	....	....
Stew, mutton (317)	14,969	....	13,381	1,097	977	1,124	1,588	130	116	133	11
Total	145,778	....	117,427	5,699	8,705	25,852	28,351	1,802	2,474	5,362	19
Total food	1,266,223	167,265	889,791	49,300	69,499	200,519	209,167	11,948	11,616	40,113	17
Dietary study No. 366.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Steak (26)	10,772	....	8,618	2,137	2,370	....	2,154	534	592	....	20
Stewed (9)	4,536	....	4,536	1,329	1,501	....	....	....	....	....	....
Roast (16)	7,257	....	4,791	1,250	1,754	....	2,466	644	903	....	34
Dried, stewed (33)	3,969	....	3,062	291	138	181	907	86	41	54	23
Veal roast (37)	3,629	....	2,722	746	163	....	907	249	54	....	25
Total	30,163	....	23,729	5,753	5,926	181	6,434	1,513	1,590	54	21
Pork:											
Ham (53)	2,836	....	2,552	541	750	....	284	60	83	....	10
Bacon (52)	2,495	....	2,041	445	1,161	....	454	99	258	....	18
Chops (42)	3,402	....	1,616	393	456	197	1,786	434	504	218	53
Total	8,733	....	6,209	1,379	2,367	197	2,524	593	845	218	29

Poultry:											
Chicken, stewed (67)	13,608		6,492	786	740		7,116	861	811		52
Chicken, boiled (67)	511		511	62	58						
Total	14,119		7,003	848	798		7,116	861	811		50
Fish:											
Mackerel, salt (81)	3,062		2,268	476	587		794	167	206		26
Cod, salt (69)	3,856		2,949	584	53	239	907	180	16	73	24
Cod, baked (68)	170		170	22							
Total	7,088		5,387	1,082	640	239	1,701	347	222	73	24
Eggs:											
Fried (86)	8,619		8,392	1,141	1,653		227	31	45		3
Boiled (84)	10,631		10,404	1,290	1,113		227	28	24		2
Scrambled (87)	8,874		7,513	1,007	1,540		1,361	182	279		15
Total	28,124		26,309	3,438	4,306		1,815	241	318		6
Butter (88)	11,062		11,028	110	9,374		3,034	30	2,579		22
Milk and cream:											
Milk (91)	306,635		282,725	9,330	11,309	14,137	23,900	789	956	1,195	8
Cream, evaporated (90)	681		681	65	63	76					
Total	307,316		283,416	9,395	11,372	14,213	23,900	789	956	1,195	8
Total animal food	409,605		363,081	22,005	34,783	14,830	46,524	4,374	7,351	1,540	11
VEGETABLE FOOD.											
Cereals:											
Corn-meal mush (98)	5,556		2,154	28	9	310	3,402	44	14	490	61
Hominy (94)	8,845		6,407	128	58	1,217	2,438	49	22	463	28
Oatmeal (113)	34,785		18,002	468	216	1,890	16,783	436	201	1,762	48
Rice, boiled (124)	27,329		16,103	193		1,948	11,226	135		1,358	41
Bread (133)	98,715	7,996	49,924	4,593	649	26,510	40,795	3,753	530	21,662	45
Corn bread (132)	4,536		2,580	152	281	978	1,956	115	215	741	43
Gingerbread (141)	1,588		1,588	92	143	1,008					
Toast (136)	25,146	935	16,415	1,889	263	10,046	7,796	897	125	4,771	32
Cake (137)	2,949		2,949	186	136	1,678					
Total	209,449	8,931	116,122	7,729	1,758	45,585	84,396	5,429	1,107	31,247	40
Vegetables:											
Beets, boiled (158)	8,504		4,224	76	25	583	4,280	77	26	591	50
Corn, stewed (179)	9,526		6,804	211	218	1,374	2,722	84	87	550	29
Peas, canned (189)	4,422		1,927	75	19	225	2,495	97	25	292	56
Potatoes, mashed and creamed (230)	14,062		11,113	278	322	1,945	2,949	74	86	516	21
Potatoes, boiled (207)	13,661		6,520	124	7	978	7,144	136	7	1,072	52
Potatoes, baked (203)	9,922		4,082	102	4	816	5,840	146	6	1,168	59
Sweet potatoes, baked (257)	8,165		6,804	163	401	2,443	1,361	33	80	489	17

Table 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 366—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Soup, bean (239)	15,139		15,139	318	30	1,014					
Squash, boiled (254)	4,989		2,608	50	18	318	2,381	45	17	290	48
Turnips, mashed (270)	4,762		2,835	37	6	230	1,927	25	4	156	40
Tomatoes, stewed (268)	4,196		1,247	20	17	157	2,949	47	41	372	70
Total	97,351		63,303	1,454	1,067	10,083	34,048	764	379	5,496	36
Fruits, etc.:											
Apples, baked (276)	9,299		5,217	16	21	955	4,082	12	16	747	44
Bananas, raw (280)	2,892		2,580	34	15	568	312	4	2	69	11
Grapes (281)	9,525	1,814	7,711	77	93	1,110					
Prunes, stewed (291)	5,273		3,572	29		1,461	1,701	14		696	32
Sauce, apple (302)	4,706		4,054	16	16	1,127	652	3	3	181	14
Total	31,695	1,814	23,134	172	145	5,221	6,747	33	21	1,693	21
Total vegetable food	338,495	10,745	202,559	9,355	2,970	60,889	125,191	6,226	1,507	38,436	37
MISCELLANEOUS FOOD.											
Custard, plain (336)	8,477		5,132	287	257	857	3,345	187	167	559	39
Hash (308)	8,505		4,876	614	492	502	3,629	457	367	374	43
Jelly, lemon (342)	7,937		6,463	200		1,137	1,474	46		259	19
Oysters, scalloped (322)	2,722		2,268	172	313	755	454	34	63	151	17
Pudding, bread (353)	5,329		4,422	115	102	977	907	24	21	200	17
Pudding, rice (364)	4,537		3,856	147	127	625	681	26	22	110	15
Pie, squash (352)	3,629		3,629	160	305	787					
Sauce, custard (338)	1,134		1,134	56	48	180					
Soup, oyster (326)	6,237		3,969	99	99	143	2,268	57	57	82	36
Stew, oyster (323)	907		907	40	47	47					
Soup, clam (325)	7,824		7,824	196	196	282					
Total	57,238		44,480	2,086	1,986	6,292	12,758	831	697	1,735	22
Total food	805,338	10,745	610,120	33,446	39,739	82,011	184,473	11,431	9,555	41,711	23

Dietary study No. 567.

ANIMAL FOOD.											
Beef:											
Corned (31)	9,298	...	5,556	1,633	1,228	...	3,742	1,100	827	...	40
Steak (26)	10,206	...	7,711	1,912	2,121	...	2,495	619	686	...	24
Total	19,504	...	13,267	3,545	3,349	...	6,237	1,719	1,513	...	32
Pork:											
Jowl (46)	10,886	...	7,824	1,424	3,951	...	3,062	557	1,546	...	28
Roast (45)	7,937	...	6,010	1,316	1,593	...	1,927	422	511	...	24
Sausage (62)	10,093	...	9,469	1,903	5,236	152	624	125	345	10	6
Shoulder (56)	7,257	1,927	5,330	1,205	2,159	...	...	...	...	...	...
Total	36,173	1,927	28,633	5,848	12,939	152	5,613	1,104	2,402	10	16
Fish:											
Cod, baked (68)	13,154	...	7,059	911	14	...	6,095	786	12	...	46
Mackerel, in salt (81)	7,938	...	2,722	572	705	...	5,216	1,095	1,351	...	66
Total	21,092	...	9,781	1,483	719	...	11,311	1,881	1,363	...	54
Eggs, boiled (84)	11,680	...	11,680	1,448	1,250	...	...	...	...	...	...
Butter (88)	27,499	...	24,522	245	20,844	...	2,977	30	2,530	...	11
Cheese (89)	3,289	...	3,062	793	1,032	73	227	59	76	5	7
Cream, evaporated (90)	22,793	...	22,680	2,177	2,109	2,540	113	11	11	13	...
Total animal food	142,030	1,927	113,625	15,539	42,242	2,765	26,478	4,804	7,895	28	19
VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	286,051	25,855	212,029	19,507	2,756	112,587	48,167	4,431	626	25,577	17
Cake, plain (137)	7,030	...	6,010	379	276	3,420	1,020	64	47	581	15
Gingerbread (141)	7,767	...	5,613	326	505	3,564	2,154	125	194	1,368	28
Hominy (94)	33,567	...	12,021	240	108	2,284	21,546	431	194	4,094	64
Mush (98)	15,309	...	8,278	108	33	1,192	7,031	91	28	1,012	46
Oatmeal (113)	16,103	...	8,392	218	101	881	7,711	200	93	810	48
Wheat breakfast food (127)	33,113	...	18,938	341	76	2,595	14,175	255	57	1,942	43
Total	398,940	25,855	271,281	21,119	3,855	126,523	101,804	5,597	1,239	35,384	26
Sugars and starches:											
Molasses (144)	8,958	...	8,958	...	...	6,271	...	...	...	...	...
Sugar (146)	61,633	...	61,633	...	...	61,633	...	...	...	...	...
Total	70,591	...	70,591	...	...	67,904	...	...	...	...	...
Vegetables:											
Beans, baked (152)	38,216	...	31,072	2,424	2,455	7,209	7,144	557	564	1,657	19
Beans, kidney, boiled (154)	13,722	...	9,753	985	78	2,614	3,969	401	32	1,064	29
Beets, boiled (158)	14,061	...	7,824	141	47	1,080	6,237	112	37	861	44

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 367—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Cabbage, boiled (166)	30,391		20,979	399	84	1,385	9,412	179	38	621	31
Peas, canned (189)	13,041		10,206	398	102	1,194	2,835	111	28	332	22
Pickles, cucumber (190)	6,576		4,195	21	13	113	2,381	12	7	64	36
Potatoes, steamed (207)	59,421	16,556	33,680	640	34	5,052	9,185	175	9	1,378	15
Sweet potatoes, steamed (258)	79,719	10,546	56,813	795	341	12,442	12,360	173	74	2,707	16
Sweet potatoes, baked (256)	13,721		11,794	271	71	3,373	1,927	44	12	551	14
Slaw (236)	9,185		9,185	147	28	514					
Sauce, rhubarb (234)	16,046		8,335	42	50	1,925	7,711	39	46	1,781	48
Soup, bean (239)	19,051		19,051	400	38	1,276					
Total	313,150	27,102	222,887	6,663	3,341	38,177	63,161	1,803	847	11,016	20
Fruits, etc.:											
Apple butter (278)	22,339	3,062	10,319	52		4,871	8,958	45		4,228	40
Jelly, currant (293)	13,608	7,258	6,350	25		4,064					
Sauce, apple (302)	15,649		9,639	39	39	2,680	6,010	24	24	1,671	38
Prunes, stewed (291)	30,504		18,824	151		7,699	11,680	93		4,777	38
Sauce, peach (307)	20,951		8,449	161	34	2,687	12,502	238	50	3,976	59
Total	103,051	10,320	53,581	428	73	22,001	39,150	400	74	14,652	38
Total vegetable food	885,732	63,277	618,340	28,210	7,269	254,605	204,115	7,800	2,160	61,052	23
MISCELLANEOUS FOOD.											
Hash (308)	17,349		13,267	1,672	1,340	1,367	4,082	514	412	420	24
Liver and bacon (310)	7,598		5,897	1,521	2,371	47	1,701	439	684	14	22
Macaroni and tomatoes (334)	17,576		11,226	393	56	2,155	6,350	222	32	1,219	36
Pie, apple (344)	18,598		18,598	353	1,246	5,393					
Pie, squash (352)	13,013		12,304	541	1,034	2,670	709	31	60	154	5
Pudding, steamed (367)	13,155		10,433	449	574	5,790	2,722	117	150	1,511	21
Stew, beef (316)	36,628		30,618	3,031	2,817	2,143	6,010	595	553	421	16
Total	123,917		102,343	7,960	9,438	19,565	21,574	1,918	1,891	3,739	17
Total food	1,151,679	65,204	834,308	51,709	58,949	276,935	252,167	14,522	11,946	64,819	22

Dietary study No. 368.											
ANIMAL FOOD.											
Beef:											
Corned (31)	2,551	....	1,531	450	340	....	1,020	300	225	....	40
Steak, fried (26)	2,608	....	1,247	309	343	....	1,361	338	374	....	52
Total	5,159	....	2,778	759	683	....	2,381	638	599	....	46
Pork:											
Jowl (46)	2,834	....	1,927	351	973	....	907	165	458	....	32
Roast (45)	2,495	....	1,701	373	451	....	794	174	210	....	32
Sausage (62)	2,154	....	2,041	410	1,129	33	113	23	62	2	5
Shoulder (56)	1,474	....	1,020	231	413	....	454	103	184	....	31
Total	8,957	....	6,689	1,365	2,966	33	2,268	465	914	2	25
Fish:											
Mackerel, salt, boiled (81)	3,062	....	1,474	310	382	....	1,588	333	411	....	52
Cod, baked (68)	4,309	....	2,211	285	4	....	2,098	271	4	....	49
Total	7,371	....	3,685	595	386	....	3,686	604	415	....	50
Butter (88)	7,371	....	6,605	66	5,614	....	766	8	651	....	10
Cheese (89)	1,020	....	935	242	315	22	85	22	29	2	8
Milk and cream:											
Milk (91)	25,686	....	25,686	848	1,027	1,284	....	....	....	....	....
Cream, evaporated (90)	2,721	....	2,608	250	243	292	113	11	11	13	4
Total	28,407	....	28,294	1,098	1,270	1,576	113	11	11	13	....
Total animal food	58,285	....	48,986	4,125	11,234	1,631	9,299	1,748	2,619	17	16
VEGETABLE FOOD.											
Cereals:											
Bread (133)	87,885	9,469	60,726	5,587	789	32,246	17,690	1,627	230	9,393	20
Oatmeal (113)	4,196	....	2,608	68	31	274	1,588	41	19	167	38
Gingerbread (141)	2,211	....	1,304	76	117	828	907	53	82	576	41
Mush (98)	4,252	....	2,438	32	10	351	1,814	24	7	261	43
Hominy (94)	8,618	....	3,969	79	36	754	4,649	93	42	883	51
Wheat breakfast food (127)	7,938	....	5,103	92	20	699	2,835	51	11	388	36
Rice, boiled (124)	4,422	....	2,041	24	....	247	2,381	29	....	288	54
Cake, plain (137)	1,927	....	1,927	121	89	1,096	....	....	....	....	....
Total	121,449	9,469	80,116	6,079	1,092	36,495	31,864	1,918	391	11,956	26
Sugar (146)	10,773	....	10,773	....	....	10,773	....	....	....	....	....
Vegetables:											
Cabbage, boiled (166)	8,959	....	5,217	99	21	344	3,742	71	15	217	42
Sweet potatoes, steamed (258)	18,938	....	13,778	193	83	3,017	5,160	72	31	1,130	27

Table 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 368—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Sauce, rhubarb (234)	5,442	....	2,154	11	13	498	3,288	16	20	760	60
Beans, kidney, boiled (154)	3,401	....	1,474	149	12	395	1,927	195	15	516	57
Soup, bean (239)	8,618	....	8,618	181	17	577	....	....	....	....	....
Beans, baked (152)	9,753	....	8,165	637	645	1,894	1,588	124	125	368	16
Potatoes, steamed (207)	14,855	....	9,412	179	9	1,412	5,443	103	5	816	37
Pickles, cucumber (190)	2,154	....	1,020	5	3	28	1,134	6	3	31	53
Beets, boiled (158)	3,855	....	1,474	27	9	203	2,381	43	14	329	62
Cabbage slaw (236)	2,041	....	1,474	24	4	83	567	9	2	32	28
Peas, canned (189)	2,154	....	2,154	84	22	252	....	....	....	....	....
Total	80,170	....	54,940	1,589	838	8,703	25,230	639	230	4,229	31
Fruits, etc.:											
Prunes, stewed (291)	4,820	....	2,552	20	....	1,044	2,268	18	....	928	47
Sauce, peach (307)	5,783	....	2,608	50	10	829	3,175	60	13	1,010	55
Sauce, apple (302)	9,865	....	6,350	25	25	1,765	3,515	14	14	977	36
Apple butter (278)	2,665	....	1,077	5	....	508	1,588	8	....	750	60
Jelly, currant (293)	8,618	....	3,515	14	....	2,250	5,103	20	....	3,266	59
Total	31,751	....	16,102	114	35	6,396	15,649	120	27	6,931	49
Total vegetable food	244,143	9,469	161,931	7,782	1,965	62,367	72,743	2,677	648	23,116	30
MISCELLANEOUS FOOD.											
Hash (308)	4,763	....	4,082	514	412	420	681	86	68	70	14
Stew, beef (316)	7,370	....	6,350	629	584	445	1,020	101	94	71	14
Pudding, fruit (367)	2,268	....	2,268	98	125	1,259	....	....	....	....	....
Macaroni and tomato (334)	4,082	....	3,062	107	15	588	1,020	36	5	196	25
Custard, plain (336)	681	....	681	38	34	114	....	....	....	....	....
Pie, apple (344)	4,252	....	4,252	81	285	1,233	....	....	....	....	....
Liver and bacon (310)	2,155	....	1,474	380	593	12	681	176	274	5	32
Pie, squash (352)	3,373	....	3,373	148	283	732	....	....	....	....	....
Total	28,944	....	25,542	1,995	2,331	4,803	3,402	399	441	342	12
Total food	331,372	9,469	236,459	13,902	15,530	68,801	85,444	4,824	3,708	23,475	26

Dietary study No. 369.

ANIMAL FOOD.											
Beef:											
Corned (28)	2,155	....	567	130	98	....	1,588	364	275	....	74
Corned (31)	680	....	567	167	126	....	113	33	25	....	17
Boiled (3)	3,062	....	454	77	114	....	2,608	441	657	....	85
Dried, stewed (33)	2,439	....	709	67	32	42	1,730	164	78	102	71
Roast (16)	3,061	....	2,041	533	747	....	1,020	266	373	....	33
Roast (15)	5,897	2,552	1,871	428	449	....	1,474	338	354	....	25
Steak (26)	1,758	....	1,191	295	328	....	567	141	156	....	32
Stewed (3)	4,025	....	1,842	311	464	....	2,183	369	550	....	54
Total	23,077	2,552	9,242	2,008	2,358	42	11,283	2,116	2,468	102	49
Pork:											
Ham, fried (53)	2,835	....	2,381	505	700	....	454	96	134	....	16
Sausage (62)	2,608	341	1,927	387	1,066	31	340	68	188	5	13
Shoulder (55)	7,370	4,423	1,020	174	275	....	1,927	329	520	....	26
Shoulder (56)	681	....	454	103	184	....	227	51	92	....	33
Total	13,494	4,764	5,782	1,169	2,225	31	2,948	544	934	5	22
Fish:											
Cod, baked (68)	1,928	....	1,134	146	2	....	794	102	2	....	41
Mackerel, salt (81)	1,588	....	681	143	176	....	907	191	235	....	57
Total	3,516	....	1,815	289	178	....	1,701	293	237	....	48
Butter (88)	6,350	226	5,245	53	4,458	....	879	9	747	....	14
Cheese (89)	851	....	851	220	287	20	....	....	....	....	....
Eggs, boiled (84)	681	....	454	56	49	....	227	28	24	....	33
Milk (91)	15,253	....	15,253	503	610	763	....	....	....	....	....
Total animal food	63,222	7,542	38,642	4,298	10,165	856	17,038	2,990	4,410	107	27
VEGETABLE FOOD.											
Cereals:											
Bread (133)	43,659	4,592	25,886	2,382	337	13,746	13,181	1,213	171	6,999	30
Cake (137)	1,305	....	851	54	39	484	454	29	21	258	35
Hominy (94)	6,237	....	1,758	35	16	334	4,479	90	40	851	72
Oatmeal, boiled (113)	25,514	....	7,739	201	93	813	17,775	462	213	1,867	70
Rice, boiled (124)	5,189	....	369	4	....	45	4,820	58	....	583	93
Total	81,904	4,592	36,603	2,676	485	15,422	40,709	1,852	445	10,558	50
Sugar (146)	3,062	....	3,062	....	....	3,062	....	....	....	....	....
Vegetables:											
Beans, baked (152)	8,051	....	1,814	142	143	421	6,237	487	493	1,447	77
Beets, boiled (158)	1,645	964	681	12	4	94	....	....	....	....	....
Cabbage, boiled (166)	7,938	....	3,317	63	13	219	4,621	88	19	305	58

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 369—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Celery (169)	680	....	567	5	1	15	113	1	....	3	17
Potatoes, baked (203)	10,263	2,296	2,779	70	3	556	5,188	130	5	1,038	51
Potatoes, boiled (213)	6,124	1,985	2,835	65	....	550	1,304	30	....	253	21
Potatoes, fried (222)	4,649	....	3,487	87	289	750	1,162	29	97	250	25
Potatoes, mashed and creamed (230)	11,029	....	7,995	200	232	1,399	3,034	76	88	531	28
Soup, bean (239)	4,990	....	1,361	29	3	91	3,629	76	7	243	73
Soup, pea (241)	10,319	....	6,577	237	46	499	3,742	135	26	284	36
Soup, tomato (245)	5,670	....	2,835	8	14	136	2,835	9	14	136	50
Soup, vegetable (253)	2,608	....	1,588	11	....	95	1,020	7	....	61	39
Slaw (236)	5,415	....	2,381	38	7	133	3,034	48	9	170	56
Squash, boiled (254)	2,665	....	681	13	5	83	1,984	37	14	242	74
Sweet potatoes, baked (256)	10,490	....	5,585	129	33	1,597	4,905	113	29	1,403	47
Sweet potatoes (257)	3,233	....	2,637	63	156	947	596	14	35	214	18
Turnips, mashed (269)	8,334	....	4,139	62	8	377	4,195	63	8	382	50
Total	104,103	5,245	51,259	1,234	957	7,962	47,599	1,343	844	6,962	46
Fruits, etc.:											
Apples, baked (276)	2,326	....	823	2	3	151	1,503	5	6	275	65
Sauce, apple (302)	5,499	....	3,430	14	14	953	2,069	8	8	575	37
Prunes, stewed (291)	5,500	....	1,758	14	....	719	3,742	30	....	1,531	68
Sauce, peach (307)	7,003	3,318	113	2	1	36	3,572	68	14	1,136	51
Sauce, cranberry (303)	3,913	....	3,913	....	....	1,194	....	....	....	....	....
Total	24,241	3,318	10,037	32	18	3,053	10,886	111	28	3,517	45
Total vegetable food	213,310	13,155	100,961	3,942	1,460	29,497	99,194	3,306	1,317	21,037	47
MISCELLANEOUS FOOD.											
Custard, baked (336)	3,856	....	2,779	156	139	464	1,077	60	54	180	28
Liver and bacon (310)	1,928	....	1,247	322	501	10	681	176	274	6	35
Pie, mince (348)	3,430	....	3,430	199	422	1,307	....	....	....	....	....
Pie, rhubarb (351)	2,381	....	2,381	74	233	1,019	....	....	....	....	....
Pudding, blanc-mange (357)	1,928	....	567	17	4	192	1,361	41	10	461	71
Pudding, bread (353)	5,329	....	1,814	47	42	401	3,515	91	81	777	66

Pudding, rice (364)	4,309	....	3,062	116	101	496	1,247	47	41	202	97
Sauce for pudding (372)	1,361	....	1,134	37	45	57	227	8	9	11	13
Soup, oyster (326)	4,990	....	3,856	96	96	139	1,134	28	28	41	22
Total	29,512	....	20,270	1,064	1,583	4,085	9,242	451	497	1,678	31
Total food	306,044	20,697	159,873	9,304	13,208	34,438	125,474	6,747	6,224	22,822	41
Dietary study No. 370.											
ANIMAL FOOD.											
Beef:											
Corned (28)	5,783	....	5,783	1,324	1,001	....	....	....	....	....	....
Corned (31)	2,267	....	1,247	367	277	....	1,020	300	226	....	45
Boiled (3)	6,917	5,103	1,814	307	457	....	....	....	....	....	....
Dried smoked, stewed (33)	4,111	....	709	67	32	42	3,402	323	153	201	83
Roast (16)	6,010	2,607	2,722	710	996	....	681	178	249	....	11
Roast (15)	11,936	4,423	3,771	864	905	....	3,742	857	898	....	31
Steak (26)	3,204	....	2,523	626	694	....	681	169	187	....	21
Stewed (3)	5,585	....	3,175	537	800	....	2,410	407	607	....	43
Total	45,813	12,133	21,744	4,802	5,162	42	11,936	2,234	2,320	201	26
Pork:											
Ham, fried (53)	7,031	2,382	3,742	793	1,100	....	907	192	267	....	13
Sausage (62)	6,181	1,361	4,366	878	2,414	70	454	91	251	7	7
Shoulder (55)	16,387	6,691	8,222	1,406	2,220	....	1,474	252	398	....	9
Shoulder (56)	2,494	....	1,474	333	597	....	1,020	231	413	....	41
Total	32,093	10,434	17,804	3,410	6,331	70	3,855	766	1,329	7	12
Fish:											
Cod, baked (68)	3,402	....	2,041	263	4	....	1,361	176	27	....	40
Mackerel, salt (81)	3,628	....	1,701	357	441	....	1,927	405	499	....	53
Total	7,030	....	3,742	620	445	....	3,288	581	526	....	47
Eggs:											
Boiled (85)	3,402	....	2,495	349	299	....	907	127	109	....	27
Fried (86)	907	....	907	123	179	....	....	....	....	....	....
Total	4,309	....	3,402	472	478	....	907	127	109	....	21
Butter (88)	17,690	....	17,690	177	15,037	....	....	....	....	....	....
Cheese (89)	1,588	681	907	235	306	22	....	....	....	....	....
Cream, evaporated (90)	4,082	680	3,402	327	316	381	....	....	....	....	....
Milk (91)	57,523	....	57,523	1,898	2,301	2,876	....	....	....	....	....
Total animal food	170,128	23,928	126,214	11,941	30,376	3,391	19,986	3,708	4,284	208	12

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 370—Continued.											
VEGETABLE FOOD.											
Cereals:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Bread (133)	83, 717	4, 280	62, 852	5, 782	817	33, 374	16, 585	1, 526	216	8, 807	20
Crackers (134)	7, 371		7, 371	722	671	5, 388					
Cake (137)	1, 588		1, 588	100	73	904					
Dressing, bread (142)	2, 523		1, 474	136	19	783	1, 049	97	14	557	41
Hominy (94)	11, 284		7, 258	145	65	1, 379	4, 026	81	36	765	36
Oatmeal (113)	46, 152		32, 092	834	385	3, 370	14, 060	366	169	1, 476	30
Rice, boiled (124)	7, 172		5, 698	68		689	1, 474	18		178	21
Total	159, 807	4, 280	118, 333	7, 787	2, 030	45, 887	37, 194	2, 088	435	11, 783	23
Sugar (146)	26, 082		26, 082			26, 082					
Vegetables:											
Beans, baked (152)	15, 140		4, 337	338	343	1, 006	10, 803	843	853	2, 506	71
Beets, boiled (158)	2, 977	1, 588	1, 389	25	8	192					
Cabbage, boiled (166)	9, 809		5, 330	101	21	352	4, 479	85	18	296	46
Celery (169)	1, 020		907	8	1	24	113	1		3	11
Potatoes, baked (203)	15, 394	2, 297	6, 775	169	7	1, 355	6, 322	158	6	1, 264	41
Potatoes, boiled (213)	10, 432		4, 706	108		913	5, 726	132		1, 111	50
Potatoes, fried (222)	7, 088		6, 407	160	532	1, 378	681	17	57	146	10
Potatoes, mashed and creamed (230)	18, 568		15, 053	376	437	2, 634	3, 515	88	102	615	19
Slaw (236)	9, 808		2, 069	33	6	116	7, 739	124	23	433	79
Squash, boiled (254)	4, 337		1, 134	22	8	138	3, 203	61	22	391	74
Soup, bean (239)	9, 185		9, 185	193	18	615					
Soup, pea (241)	18, 598		14, 742	531	103	1, 120	3, 856	139	27	293	21
Soup, tomato (245)	8, 392		8, 392	25	42	403					
Soup, vegetable (253)	9, 412		7, 711	54		46	1, 701	12		102	18
Sweet potatoes, baked (256)	17, 209		9, 696	223	58	2, 773	7, 513	173	45	2, 149	44
Sweet potatoes, steamed and baked (257)	4, 451		4, 451	107	263	1, 598					
Turnips, mashed (269)	13, 125		10, 999	165	22	1, 001	2, 126	32	4	194	16
Total	174, 945	3, 885	113, 283	2, 638	1, 869	15, 664	57, 777	1, 865	1, 157	9, 503	33
Fruits, etc.:											
Apples, baked (276)	4, 678		3, 629	11	15	664	1, 049	3	4	192	22
Prunes, stewed (291)	13, 608		5, 897	47		2 412	7, 711	6		3, 154	57

Sauce, apple (302)	7,173	....	5,274	21	21	1,466	1,899	8	8	528	26
Sauce, cranberry (303)	9,186	....	8,392	....	....	2,560	794	....	....	242	9
Sauce, peach (307)	13,296	....	4,082	78	16	1,298	9,214	175	37	2,930	69
Total	47,941	....	27,274	157	52	8,400	20,667	192	49	7,046	43
Total vegetable food	408,775	8,165	284,972	10,582	3,951	96,033	115,638	4,145	1,641	28,332	28
MISCELLANEOUS FOOD.											
Custard, baked (336)	6,577	....	6,577	368	329	1,098	....	....	....	....	....
Liver and bacon (310)	4,195	....	2,381	614	957	19	1,814	468	729	15	43
Pie, mince (348)	4,252	....	4,252	247	523	1,620	....	....	....	....	....
Pie, rhubarb (351)	5,103	....	5,103	158	500	2,184	....	....	....	....	....
Pudding, bread (353)	8,051	....	4,649	121	107	1,027	3,402	88	78	752	42
Pudding, blanc mange (357)	7,257	....	6,690	201	47	2,268	567	17	4	192	8
Pudding, rice (364)	4,876	....	4,876	185	161	790	....	....	....	....	....
Soup, oyster (326)	9,639	....	8,165	204	204	294	1,474	37	37	53	15
Total	49,950	....	42,693	2,098	2,828	9,300	7,257	610	848	1,012	15
Total food	628,853	32,093	453,879	24,621	37,155	108,724	142,881	8,463	6,773	29,552	23
Dietary study No. 371.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Roast (15)	20,752	1,588	9,865	2,259	2,368	....	9,299	2,129	2,232	....	45
Boiled (9)	3,856	454	2,495	731	825	....	907	266	300	....	24
Beefsteak (26)	28,123	1,361	16,443	4,077	4,522	....	10,319	2,559	2,837	....	37
Dried, stewed (33)	9,526	....	5,387	512	242	318	4,139	393	186	244	43
Lamb, roast, leg (38)	10,546	....	5,103	1,179	1,005	....	5,443	1,257	1,072	....	52
Veal cutlets (36)	7,258	....	4,763	1,272	800	....	2,495	666	419	....	31
Total	80,061	3,403	44,056	10,030	9,762	318	32,602	7,270	7,046	244	41
Fish:											
Halibut, boiled (71)	11,907	....	7,144	1,621	450	....	4,763	1,081	300	....	40
Mackerel, salt (81)	5,329	....	4,309	905	1,116	....	1,020	214	264	....	19
Salmon, canned (82)	6,804	....	4,479	976	542	....	2,325	507	281	....	34
Total	24,040	....	15,932	3,502	2,108	....	8,108	1,802	845	....	34
Poultry:											
Chicken, fricasseed (66)	15,422	....	10,093	1,080	939	293	5,329	570	496	155	35
Chicken, stewed (67)	15,422	....	10,319	1,249	1,176	....	5,103	617	582	....	33
Total	30,844	....	20,412	2,329	2,115	293	10,432	1,187	1,078	155	34

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 371—Continued.											
ANIMAL FOOD—continued.											
Eggs:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Raw (83)	39,407	....	38,613	5,058	3,591	....	794	104	74	....	2
Scrambled (87)	7,257	....	6,917	927	1,418	....	340	46	70	....	5
Total	46,664	....	45,530	5,985	5,009	....	1,134	150	144	....	2
Butter (88)	17,010	1,020	15,990	160	13,592	....	....	....	....	....	....
Milk (91)	912,756	14,515	823,737	27,183	32,949	41,187	74,504	2,459	2,980	3,725	8
Total animal food	1,111,375	18,938	965,657	49,189	65,535	41,798	126,780	12,868	12,093	4,124	11
VEGETABLE FOOD.											
Cereals:											
Bread (133)	148,101	3,742	61,917	5,696	805	32,877	82,442	7,585	1,072	43,777	56
Wheat breakfast food (126)	11,907	....	9,412	132	9	809	2,495	35	2	215	21
Shredded wheat (125)	2,721	....	1,247	132	17	971	1,474	154	21	1,148	54
Corn bread (132)	22,226	....	22,226	1,311	2,445	8,424	....	....	....	....	....
Mush (98)	12,701	....	7,031	91	28	1,012	5,670	74	23	816	45
Oatmeal (113)	69,967	....	56,700	1,474	680	5,954	13,267	345	159	1,393	19
Rice, boiled (124)	78,927	....	53,411	641	....	6,462	25,516	306	....	3,087	32
Toast, dry (136)	62,654	....	50,605	5,820	810	30,970	12,049	1,385	193	7,374	19
Crackers (134)	8,618	....	4,876	478	444	3,564	3,742	367	340	2,735	43
Cake (137)	6,010	....	5,443	343	250	3,097	567	36	26	323	9
Total	423,832	3,742	272,868	16,118	5,488	94,140	147,222	10,287	1,836	60,868	35
Sugar (146)	43,772	....	43,772	....	....	43,772	....	....	....	....	....
Vegetables:											
Potatoes, mashed and creamed (230)	40,711	....	30,335	758	880	5,309	10,376	259	301	1,816	25
Potatoes, baked (203)	84,144	....	60,556	1,514	61	12,111	23,588	590	24	4,718	28
Potatoes, browned (217)	27,216	....	20,072	502	20	4,175	7,144	179	7	1,486	26
Sweet potatoes, boiled and browned (261)	16,103	....	13,381	294	575	4,643	2,722	60	117	945	47
Sweet-potato roll (262)	10,092	....	6,804	122	306	1,952	3,288	59	148	944	33
Soup, tomato (245)	85,729	....	54,545	164	273	2,618	31,184	94	156	1,497	36
Soup, potato (242)	43,545	....	22,680	340	476	1,089	20,865	313	438	1,002	48
Soup, vegetable (253)	81,762	....	49,216	345	....	2,953	32,546	228	....	1,953	40
Soup, corn (240)	41,958	....	30,505	397	671	854	11,453	149	252	321	27

Celery (171)	1, 361	....	1, 361	15	1	45	....	....	....	....	....
Parsnips, boiled and browned (186)	7, 145	....	6, 634	133	438	1, 094	511	10	34	84	7
Tomatoes, stewed (268)	8, 391	....	6, 350	102	89	800	2, 041	33	29	257	24
Corn (179)	11, 566	....	7, 484	232	239	1, 511	4, 082	127	131	825	35
Peas (189)	6, 918	....	4, 536	177	45	531	2, 382	93	24	279	31
Total	466, 641	....	314, 459	5, 095	4, 074	39, 685	152, 182	2, 194	1, 661	16, 127	33
Fruits, etc.:											
Apples (271)	5, 783	....	5, 783	17	17	624	....	....	....	....	....
Apples, baked (276)	9, 865	....	8, 618	26	35	1, 577	1, 247	4	5	228	13
Sauce, apple (302)	26, 763	....	23, 304	93	93	6, 479	3, 459	13	13	962	13
Bananas (279)	12, 928	....	12, 928	103	52	1, 849	....	....	....	....	....
Jelly (292)	3, 856	....	3, 856	12	....	2, 699	....	....	....	....	....
Oranges (282)	6, 350	....	6, 350	38	6	540	....	....	....	....	....
Sauce, peach (307)	14, 743	....	11, 964	227	48	3, 805	2, 779	53	11	884	19
Prunes, stewed (291)	9, 638	....	8, 731	70	....	3, 571	907	7	....	371	9
Total	89, 926	....	81, 534	586	251	21, 144	8, 392	77	29	2, 445	9
Total vegetable food	1, 024, 171	3, 742	712, 633	21, 799	9, 813	198, 741	307, 796	12, 558	3, 526	79, 440	30
MISCELLANEOUS FOOD.											
Stew, beef (316)	19, 278	....	11, 113	1, 100	1, 022	778	8, 165	808	751	572	42
Ice cream (340)	15, 650	....	14, 743	575	590	3, 111	907	35	36	190	6
Chicken, creamed (319)	11, 681	....	8, 902	623	561	276	2, 779	195	175	86	24
Sauce, custard (338)	8, 959	....	8, 959	439	376	1, 424	....	....	....	....	....
Liver and bacon (310)	4, 537	....	3, 856	995	1, 550	31	681	175	273	5	15
Jelly, lemon (342)	13, 154	....	10, 432	323	....	1, 836	2, 722	84	....	479	21
Macaroni and cheese (333)	9, 072	....	3, 799	281	243	631	5, 273	390	337	875	58
Oysters, creamed (321)	8, 959	....	7, 371	346	479	464	1, 588	75	103	100	18
Stew, oyster (324)	20, 298	....	17, 917	788	932	932	2, 381	105	124	124	12
Soup, oyster (326)	41, 958	....	25, 175	629	629	906	16, 783	420	420	604	40
Pudding, bread (353)	11, 453	....	10, 319	268	237	2, 280	1, 134	29	26	251	10
Pudding, chocolate (356)	11, 567	....	9, 412	292	508	2, 165	2, 155	67	116	496	19
Pudding, floating island (362)	11, 340	....	9, 639	453	434	1, 841	1, 701	80	77	325	15
Pudding, junket (363)	15, 309	....	12, 587	327	365	1, 548	2, 722	71	80	335	18
Pudding, rice (364)	13, 381	....	9, 979	379	329	1, 616	3, 402	129	112	551	25
Sauce, halibut (328)	4, 538	....	2, 723	117	261	144	1, 815	78	174	96	40
Sauce, lemon (369)	5, 217	....	4, 763	100	76	905	454	10	7	86	9
Total	226, 351	....	171, 689	8, 035	8. 592	20, 888	54, 662	2, 751	2, 811	5, 175	24
Total food	2, 361, 897	22, 680	1, 849, 979	79, 023	83, 940	261, 427	489, 238	28, 177	18, 430	88, 739	21

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 372.											
ANIMAL FOOD.											
Beef:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Boiled (3)	5,783		5,783	977	1,457						
Corned (31)	11,794		9,526	2,801	2,115		2,268	667	503		19
Steak (26)	11,454		9,866	2,447	2,713		1,588	394	437		14
Boiled (9)	907		907	266	300						
Roast (15)	3,402		3,402	779	816						
Total	33,340		29,484	7,270	7,401		3,856	1,061	940		12
Pork:											
Sausage (62)	6,350		6,350	1,276	3,513	102					
Shoulder, smoked (57)	12,020		9,412	1,920	2,551		2,608	532	707		22
Pigs' feet (43)	3,062		3,062	168	279						
Chops (45)	2,495		2,495	546	661						
Roast (47)	3,629		3,629	1,002	784						
Head (46)	8,505		8,505	1,548	4,295						
Shoulder, fresh (45)	10,207		9,753	2,136	2,585		454	99	120		4
Head-cheese (44)	1,134		1,134	221	383						
Ham, fried (53)	3,515		3,515	745	1,033						
Total	50,917		47,855	9,562	16,084	102	3,062	631	827		60
Fish:											
Herring, smoked (76)	454		454	93	40						
Cod, salt, boiled (75)	6,577		3,175	914	13		3,402	980	14		52
Mackerel, salt (80)	1,588		227	60	64		1,361	357	381		86
Cod, baked (68)	10,773		7,144	922	14		3,629	469	7		34
Total	19,392		11,000	1,989	131		8,392	1,806	402		43
Butter (88)	19,278		12,077	121	10,265		7,201	72	6,121		37
Milk (91)	21,773		21,773	719	871	1,089					
Total animal food	144,700		122,189	19,661	34,752	1,191	22,511	3,570	8,290		16

VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	222,831		155,245	14,283	2,018	82,435	67,586	6,218	879	35,888	30
Crackers (134)	7,257		7,144	700	650	5,222	113	11	10	83	2
Hominy (91)	20,298		14,855	297	134	2,822	5,443	109	49	1,034	27
Oatmeal (113)	17,577		11,113	289	133	1,167	6,464	168	78	679	37
Rice (124)	17,350		9,412	113		1,139	7,938	95		961	46
Doughnuts (140)	6,464		6,464	433	1,357	3,434					
Wheat breakfast food (127)	10,773		5,556	100	22	761	5,217	94	21	715	48
Fritters (135)	1,021		1,021	94	13	542					
Ginger cake (141)	14,969		12,474	723	1,123	7,921	2,495	145	225	1,584	11
Mush (98)	11,567		6,804	88	27	980	4,763	62	19	686	47
Macaroni, boiled (143)	11,112		4,422	146	93	699	6,690	221	140	1,057	60
Corn bread (132)	1,588		1,361	80	150	516	227	13	25	86	14
Wheat breakfast food (128)	9,638		5,443	136	22	849	4,195	105	17	654	44
Cake (137)	6,577		6,577	414	303	3,742					
Total	359,022		247,891	17,896	6,045	112,229	111,131	7,241	1,463	43,427	31
Sugar (146)	12,474		12,474			12,474					
Vegetables:											
Potatoes, steamed (207)	29,484		19,618	373	20	2,942	9,866	187	10	1,480	33
Potatoes, steamed (210)	11,226		6,804	163		1,367	4,422	106		889	39
Potatoes, baked (203)	4,763		4,763	119	5	953					
Potatoes, browned (217)	6,010		5,783	145	6	1,203	227	6		47	4
Potatoes, stewed (230)	2,608		2,608	65	76	456					
Potatoes, fried (222)	2,721		1,814	45	151	390	907	23	75	195	33
Potatoes, mashed and creamed (230)	5,330		5,330	133	155	933					
Cabbage, boiled (166)	15,083		12,134	231	49	801	2,949	56	12	195	20
Soup, bean (239)	107,389		59,648	1,253	119	3,996	47,741	1,003	95	3,199	44
Soup, tomato (245)	7,031		1,814	5	9	87	5,217	16	26	250	74
Soup, vegetable (253)	44,226		27,216	191		1,633	17,010	119		1,021	38
Sauce, rhubarb (234)	26,875		17,917	90	108	4,139	8,958	45	54	2,069	33
Beans, Lima, boiled (155)	8,164		4,876	273	24	1,004	3,288	184	16	677	40
Beans, baked (152)	10,886		7,371	575	582	1,710	3,515	274	278	816	32
Beans, baked (151)	8,392		6,804	606	401	1,796	1,588	141	94	419	19
Peas, stewed (189)	5,556		5,556	217	56	650					
Salad, celery (171)	907		907	10	1	30					
Turnips, mashed (269)	12,814		11,680	175	23	1,063	1,134	17	2	103	9
Succotash (255)	8,165		7,031	295	148	1,378	1,134	48	24	222	14
Pickles, cucumber (190)	2,155		2,155	11	6	58					
Tomato preserves (265)	1,361		1,361	24	5	347					
Tomatoes, stewed (268)	8,846		7,258	116	102	915	1,588	25	22	200	18
Total	329,992		220,448	5,115	2,046	27,851	109,544	2,250	708	11,782	33
Fruits, etc.:											
Sauce, apple, evaporated (300)	30,051		24,268	97	121	7,353	5,783	23	29	1,752	19
Prunes, stewed (291)	11,793		10,886	87		4,452	907	7		371	8
Total	41,844		35,154	184	121	11,805	6,690	30	29	2,123	16
Total vegetable food	743,332		515,967	23,195	8,212	164,359	227,365	9,521	2,200	57,332	31

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 372—Continued.											
MISCELLANEOUS FOOD.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Dumplings, apple (339)	2,381	....	2,381	74	233	1,019	....	....	....	....	....
Stew, beef (316)	31,071	....	25,061	2,481	2,306	1,754	6,010	595	553	421	19
Pudding, bread (353)	5,671	....	5,217	136	120	1,153	454	12	10	100	8
Stew, pork (316)	14,968	....	11,680	1,156	1,075	818	3,288	326	302	230	22
Liver and bacon (310)	5,897	....	5,897	1,521	2,371	47	....	....	....	....	....
Pudding, tapioca (368)	2,949	....	2,949	97	94	832	....	....	....	....	....
Pudding, rice (364)	2,949	....	2,949	112	97	478	....	....	....	....	....
Pudding, steamed (366)	7,598	....	7,598	372	676	4,118	....	....	....	....	....
Pudding, cornstarch (357)	2,381	....	2,381	71	17	807	....	....	....	....	....
Codfish cakes (318)	1,474	....	1,474	286	144	225	....	....	....	....	....
Pie, apple, evaporated (344)	13,608	....	13,608	259	912	3,946	....	....	....	....	....
Total	90,947	....	81,195	6,565	8,045	15,197	9,752	933	865	751	11
Total food	978,979	....	719,351	49,421	51,009	180,747	259,628	14,024	11,355	58,083	27
Dietary study No. 373.											
ANIMAL FOOD.											
Beef and mutton:											
Boiled (9)	9,298	....	6,917	2,027	2,290	....	2,381	698	788	....	26
Chipped, fried (32)	680	....	680	204	44	....	....	....	....	....	....
Corned (31)	13,722	....	10,093	2,967	2,241	....	3,629	1,067	806	....	26
Roast (14)	8,845	....	8,845	1,831	1,928	....	....	....	....	....	....
Roast (17)	7,371	....	5,897	1,403	1,474	....	1,474	351	369	....	20
Sausage, Bologna (35)	794	....	794	148	140	2	....	....	....	....	....
Steak, fried (26)	15,876	....	14,855	3,684	4,085	....	1,021	253	281	....	6
Mutton, chops (39)	2,495	....	2,155	397	575	....	340	63	91	....	14
Mutton, roast (38)	2,722	....	2,722	629	536	....	....	....	....	....	....
Total	61,803	....	52,958	13,290	13,313	2	8,845	2,432	2,335	....	14
Pork:											
Boiled (41)	2,041	....	2,041	320	741	....	....	....	....	....	....
Ham, fried (53)	3,175	....	3,175	673	933	....	....	....	....	....	....
Head-cheese (44)	1,247	....	1,247	243	421	....	....	....	....	....	....
Sausage, fried (62)	6,577	....	6,350	1,276	3,512	102	227	46	126	4	3

Shoulder (56)	907		907	205	367						
Shoulder (55)	10,773		7,938	1,357	2,143		2,835	485	765		26
Total	24,720		21,658	4,074	8,117	102	3,062	531	891	4	12
Fish:											
Haddock, baked (72)	12,361		10,773	970	1,271	205	1,588	143	187	30	13
Mackerel, salt (80)	9,752		7,938	2,080	2,223		1,814	475	508		19
Total	22,113		18,711	3,050	3,494	205	3,402	618	695	30	15
Butter (88)	21,092		17,350	174	14,748		3,742	37	3,181		18
Milk (91)	38,102		38,102	1,257	1,524	1,905					
Total animal food	167,830		148,779	21,845	41,196	2,214	19,051	3,618	7,102	34	11
VEGETABLE FOOD.											
Cereals:											
Bread, biscuits, etc. (133)	280,665		228,841	21,053	2,975	121,515	51,824	4,768	674	27,519	18
Cake, plain (137)	10,886		10,886	686	501	6,191					
Cornbread (132)	2,268		2,268	134	249	860					
Crackers, soda (134)	10,432		10,432	1,022	949	7,626					
Doughnuts (140)	10,660		10,660	714	2,239	5,660					
Gingerbread (141)	22,567		21,773	1,263	1,960	13,826	794	46	71	504	4
Hominy (94)	21,773		17,350	347	156	3,297	4,423	88	40	840	20
Mush, fried (98)	14,175		10,546	137	42	1,519	3,629	47	15	523	26
Oatmeal (113)	18,711		12,020	313	144	1,262	6,691	174	80	703	36
Rice, boiled (124)	28,577		16,783	201		2,031	11,794	142		1,427	41
Wheat breakfast food (128)	12,474		7,144	179	29	1,114	5,330	133	21	831	43
Wheat breakfast food (127)	16,443		9,866	178	39	1,352	6,577	118	26	901	40
Total	449,631		358,569	26,227	9,283	166,256	91,062	5,516	927	33,248	20
Sugar (146)	8,278		8,278			8,278					
Vegetables:											
Beans, kidney, boiled (154)	9,866		7,938	802	64	2,127	1,928	195	15	517	20
Beans, Lima, boiled (155)	13,607		12,700	711	64	2,616	907	51	5	187	7
Beans, baked (152)	21,773		19,618	1,530	1,550	4,551	2,155	168	170	500	10
Cabbage, boiled (166)	9,979		8,165	155	33	539	1,814	34	7	120	18
Corn, stewed (179)	3,402		3,062	95	98	619	340	11	11	69	10
Parsnips, boiled and browned (186)	1,928		1,928	39	127	318					
Pickles, cucumber (190)	1,134		1,134	6	3	31					
Peas, stewed (189)	3,515		3,515	137	35	411					
Potatoes, baked (203)	3,629		3,629	91	4	726					
Potatoes, fried (222)	3,515		2,948	74	245	634	567	14	47	122	16
Potatoes, mashed and creamed (230)	9,979		8,165	204	237	1,429	1,814	45	53	317	18
Potatoes, boiled (213)	1,361		1,361	31		264					
Potatoes, steamed (210)	32,773		27,103	650		5,448	5,670	136		1,140	17
Potatoes, steamed and browned (217)	7,258		7,031	176	7	1,462	227	6		47	3
Sauerkraut (235)	3,062		3,062	52	15	116					
Sauce, rhubarb (234)	8,618		7,371	37	44	1,703	1,247	6	7	288	14

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 373—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Soup, bean (239)	103, 534		82, 555	1, 734	165	5, 531	20, 979	441	42	1, 406	20
Soup, tomato (245)	45, 926		41, 844	126	209	2, 009	4, 082	12	20	196	9
Soup, vegetable (253)	17, 122		13, 040	91		782	4, 082	29		245	24
Sweet potatoes, baked (256)	2, 381		2, 381	55	14	681					
Tomatoes, stewed (268)	12, 360		9, 979	160	140	1, 257	2, 381	38	33	300	19
Tomatoes, preserved (265)	2, 381		2, 381	43	10	607					
Turnips, mashed (269)	30, 164		23, 927	359	48	2, 177	6, 237	94	12	568	21
Total	349, 267		291, 837	7, 358	3, 112	36, 038	54, 430	1, 280	422	6, 022	13
Fruits, etc.:											
Apples, baked (276)	1, 814		1, 814	5	7	332					
Jelly, apple (292)	6, 804		5, 330	16		3, 731	1, 474	4		1, 031	22
Prunes, stewed (291)	38, 103		36, 515	292		14, 935	1, 588	13		649	4
Sauce, apple (300)	21, 205		18, 597	74	93	5, 635	2, 608	10	13	790	12
Total	67, 926		62, 256	387	100	24, 633	5, 670	27	13	2, 170	8
Total vegetable food	875, 102		723, 940	33, 972	12, 495	235, 205	151, 162	6, 823	1, 362	41, 740	17
MISCELLANEOUS FOOD.											
Beef stew (316)	58, 741		45, 246	4, 479	4, 163	3, 167	13, 495	1, 336	1, 242	945	23
Gravy, beef (329)	2, 268		2, 268	32	188	125					
Hash, baked (308)	5, 897		5, 897	743	596	607					
Liver and bacon (310)	9, 866		9, 299	2, 399	3, 738	74	567	146	228	5	6
Macaroni and tomatoes (334)	9, 526		8, 165	286	41	1, 568	1, 361	48	7	261	14
Pie, green apple (344)	15, 422		15, 422	293	1, 033	4, 472					
Pudding, bread (353)	15, 762		13, 948	363	321	3, 083	1, 814	47	42	401	12
Pudding, cornstarch (357)	2, 722		2, 722	82	19	923					
Pudding, rice (365)	2, 722		2, 722	112	93	618					
Pudding, steamed (367)	5, 443		5, 330	229	293	2, 958	113	5	6	63	2
Sauce for pudding (370)	5, 896		5, 783	52	272	810	113	1	5	16	2
Total	134, 265		116, 802	9, 070	10, 757	18, 405	17, 463	1, 583	1, 530	1, 691	13
Total food	1, 177, 197		989, 521	64, 887	64, 448	255, 824	187. 676	12, 024	9, 994	43, 465	16

Dietary study No. 374.

ANIMAL FOOD.											
Beef and mutton:											
Steak (26)	16,896	....	16,896	4,190	4,646	....	....	....	....	....	....
Roast (17)	9,525	....	8,618	2,051	2,154	....	907	216	227	....	9
Boiled (8)	19,505	....	17,237	4,637	3,275	....	2,268	610	431	....	12
Roast (14)	24,268	....	22,907	4,742	4,994	....	1,361	282	297	....	6
Corned (31)	18,597	....	17,690	5,201	3,927	....	907	267	201	....	5
Chops, mutton (39)	9,526	....	9,526	1,753	2,543	....	....	....	....	....	....
Total	98,317	....	92,874	22,574	21,539	....	5,443	1,375	1,156	....	6
Pork:											
Ham, fried (53)	5,443	....	5,443	1,154	1,600	....	....	....	....	....	....
Sausage, fried (61)	13,494	....	13,267	3,264	7,973	279	227	56	136	5	2
Shoulder (57)	32,319	....	27,783	5,668	7,529	....	4,536	925	1,229	....	14
Chops (42)	9,072	....	9,072	2,204	2,558	1,107	....	....	....	....	....
Head-cheese (44)	4,763	....	4,763	929	1,610	....	....	....	....	....	....
Total	65,091	....	60,328	13,219	21,270	1,386	4,763	981	1,365	5	7
Fish:											
Cod, salt, boiled (75)	22,113	4,309	10,660	3,070	43	....	7,144	2,057	28	....	32
Haddock, baked (72)	19,618	....	19,164	1,725	2,261	364	454	41	54	9	2
Total	41,731	4,309	29,824	4,795	2,304	364	7,598	2,098	82	9	18
Butter (88)	28,576	....	24,494	245	20,820	....	4,082	41	3,470	....	14
Total animal food	233,715	4,309	207,520	40,833	65,933	1,750	21,886	4,495	6,073	14	9
VEGETABLE FOOD.											
Cereals:											
Bread (133)	475,939	....	416,064	38,278	5,409	220,930	59,875	5,509	778	31,794	12
Rice, boiled (124)	65,545	....	55,226	663	....	6,682	10,319	124	....	1,249	16
Hominy, fried (94)	51,143	....	44,793	896	404	8,511	6,350	127	57	1,206	12
Wheat breakfast food (128)	21,092	....	13,494	337	54	2,105	7,598	190	30	1,185	36
Cake, marble (137)	14,515	....	14,515	914	668	8,259	....	....	....	....	....
Oatmeal (113)	46,607	....	37,989	988	456	3,989	8,618	224	103	905	18
Gingerbread (141)	23,361	....	23,361	1,355	2,102	14,835	....	....	....	....	....
Mush (98)	21,999	....	15,082	196	60	2,172	6,917	90	28	996	31
Total	720,201	....	620,524	43,627	9,153	267,483	99,677	6,264	996	37,335	14
Sugar (146)	8,278	....	8,278	....	....	8,278	....	....	....	....	....
Vegetables:											
Potatoes, steamed (207)	76,545	7,258	57,040	1,084	57	8,556	12,247	233	12	1,837	16
Soup, bean (239)	245,171	....	163,523	3,434	327	10,956	81,648	1,715	163	5,470	33
Turnips, mashed (269)	18,710	....	16,783	252	34	1,527	1,927	29	4	175	10
Soup, vegetable (253)	85,957	....	85,957	602	....	5,157	....	....	....	....	....

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 374—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams*	*Grams.*	*Grams.*	*Per ct.*
Beans, baked (151)	26,083	2,722	20,866	1,857	1,231	5,508	2,495	222	147	659	10
Beans, baked (150)	33,566	....	32,432	3,146	2,076	8,173	1,134	110	73	286	3
Tomatoes, stewed (268)	22,907	2,495	18,598	298	260	2,343	1,814	29	25	229	8
Beets, boiled (158)	17,690	....	13,948	251	84	1,925	3,742	67	22	516	21
Pickles, cucumber (190)	7,258	....	6,577	33	20	176	681	3	2	18	9
Sauce, rhubarb (234)	20,979	....	14,175	71	85	3,274	6,804	34	41	1,572	32
Beans, Lima, boiled (155)	26,308	....	25,288	1,416	126	5,209	1,020	57	5	210	4
Total	581,174	12,475	455,187	12,444	4,300	52,804	113,512	2,499	494	10,972	20
Fruits, etc.:											
Sauce, peach (307)	51,030	....	42,638	810	171	13,559	8,392	159	34	2,669	16
Jelly, apple (292)	13.607	....	12,360	37	....	8,652	1,247	4	....	873	9
Prunes, stewed (290)	22,793	....	20,979	147	....	7,196	1,814	13	....	622	8
Sauce, apple (302)	46,268	....	36,969	148	148	10,277	9,299	37	37	2,585	20
Total	133,698	....	112,946	1,142	319	39,684	20,752	213	71	6,749	16
Total vegetable food	1,443,351	12,475	1,196,935	57,213	13,772	368,249	233,941	8,976	1,561	55,056	16
MISCELLANEOUS FOOD.											
Stew, beef (316)	63,390	6,804	50,123	4,962	4,611	3,509	6,463	640	595	452	10
Macaroni and tomato (334)	23,360	....	21,319	746	107	4,093	2,041	71	10	392	9
Pudding, steamed (367)	38,102	....	35,040	1,507	1,927	19,447	3,062	132	168	1,699	8
Sauce, pudding (371)	26,082	....	25,742	1,287	978	4,196	340	17	13	55	1
Hash (308)	28,350	....	26,762	3,372	2,703	2,756	1,588	200	160	164	6
Pie, apple, evaporated (344)	21,773	....	21,773	414	1,459	6,314	....	....	....	....	....
Liver and bacon (310)	13,268	....	11,794	3,043	4,741	94	1,474	380	593	12	11
Potpie, beef (316)	34,247	....	32,659	3,233	3,005	2,286	1,588	157	146	111	5
Total	248,572	6,804	225,212	18,564	19,531	42,695	16,556	1,597	1,685	2,885	7
Total food	1,925.638	23,588	1,629,667	116,610	99,236	412,694	272,383	15,068	9,319	57,955	14

Dietary study No. 375.

ANIMAL FOOD.											
Beef, veal, and mutton:											
Corned (31)	6,124	1,587	3,175	933	705	....	1,362	400	302	....	22
Beefsteak (26)	4,195	....	3,515	872	967	....	680	169	187	....	16
Boiled (9)	5,670	....	2,381	698	788	....	3,289	964	1,089	....	58
Roast (15)	5,217	....	3,629	831	871	....	1,588	364	381	....	30
Total	21,206	1,587	12,700	3,334	3,331	....	6,919	1,897	1,959	....	33
Pork:											
Sausage (62)	3,402	....	3,062	615	1,693	49	340	68	188	5	10
Shoulder (55)	6,010	....	2,381	407	643	....	3,629	621	980	....	60
Total	9,412	....	5,443	1,022	2,336	49	3,969	689	1,168	5	42
Fish:											
Cod, salt (75)	11,000	....	5,557	1,600	22	....	5,443	1,567	22	....	49
Haddock (72)	6,463	....	4,649	418	549	88	1,814	163	214	35	28
Total	17,463	....	10,206	2,018	571	88	7,257	1,730	236	35	42
Butter (88)	21,092	....	18,881	189	16,049	....	2,211	22	1,880	....	10
Total animal food	69,173	1,587	47,230	6,563	22,287	137	20,356	4,338	5,243	40	29
VEGETABLE FOOD.											
Cereals:											
Corn-meal mush (98)	3,855	....	3,742	49	15	539	113	1	....	16	3
Hominy (94)	13,721	....	7,371	147	66	1,400	6,350	127	57	1,207	46
Oatmeal (113)	6,237	....	3,175	83	38	333	3,062	80	37	322	49
Wheat breakfast food (127)	6,577	....	2,268	41	9	311	4,309	78	17	590	66
Rice, boiled (124)	11,907	....	7,258	87	....	878	4,649	56	....	563	39
Wheat breakfast food (128)	6,350	....	3,175	79	13	495	3,175	79	13	495	50
Bread (133)	106,142	9,299	74,277	6,833	966	39,441	22,566	2,076	293	11,983	21
Crackers (134)	5,897	1,021	2,948	289	268	2,155	1,928	189	175	1,409	33
Corn bread (132)	3,402	....	3,402	201	374	1,289	....	....	....	....	....
Cookies, ginger (141)	3,175	....	1,928	112	174	1,224	1,247	72	112	792	39
Dressing, bread (142)	454	....	454	42	6	241	....	....	....	....	....
Gingerbread (141)	6,804	....	5,557	322	500	3,529	1,247	72	112	792	18
Cake (137)	5,444	....	4,990	314	230	2,839	454	29	21	258	8
Total	179,965	10,320	120,545	8,599	2,659	54,674	49,100	2,859	837	18,427	27
Sugar (146)	2,268	....	2,268	....	....	2,268	....	....	....	....	....
Vegetables:											
Beans and kidney (154)	7,033	....	3,289	332	26	881	3,744	378	30	1,004	53
Beans, baked (152)	7,598	....	5,670	442	448	1,315	1,928	150	152	447	25
Cabbage, boiled (166)	7,257	....	5,443	103	22	359	1,814	34	7	120	25
Corn, stewed (179)	4,536	....	4,082	127	131	824	454	14	15	92	10

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 375—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Sauce, rhubarb (234)	11,340	....	7,371	37	44	1,704	3,969	20	24	917	35
Soup, bean (239)	65,319	....	38,443	807	77	2,576	26,876	564	54	1,801	41
Soup, vegetable (253)	19,958	....	12,020	84	....	721	7,938	56	....	476	40
Turnips, boiled (269)	5,670	....	5,103	77	10	464	567	9	1	52	10
Potatoes, steamed (207)	29,711	....	19,165	364	19	2,875	10,546	200	11	1,582	35
Total	158,422	....	100,586	2,373	777	11,719	57,836	1,425	294	6,491	37
Fruits, etc.:											
Jelly, apple (292)	8,619	....	3,856	12	....	2,699	4,763	14	....	3,334	55
Sauce, apple (302)	5,217	....	3,629	15	15	1,009	1,588	6	6	441	30
Sauce, peach (307)	12,587	....	6,237	119	25	1,983	6,350	121	25	2,019	50
Total	26,423	....	13,722	146	40	5,691	12,701	141	31	5,794	48
Total vegetable food	367,078	10,320	237,121	11,118	3,476	74,352	119,637	4,425	1,162	30,712	33
MISCELLANEOUS FOOD.											
Pudding, cottage (358)	3,062	....	3,062	193	141	1,742	....	....	....	....	....
Hominy and beans (332)	7,258	2,722	4,309	203	39	931	227	11	2	49	3
Liver and bacon (310)	3,856	....	3,289	849	1,322	26	567	146	228	5	15
Pie, evaporated apple (345)	8,846	....	7,031	218	689	3,009	1,815	56	178	777	21
Pudding, bread (353)	8,164	....	7,484	195	172	1,654	680	18	16	150	8
Sauce, pudding (370)	3,629	....	3,629	33	171	508	....	....	....	....	....
Stew, beef (316)	23,814	2,495	18,144	1,796	1,669	1,270	3,175	314	292	222	13
Total	58,629	5,217	46,948	3,487	4,203	9,140	6,464	545	716	1,203	11
Total food	494,880	17,124	331,299	21,168	29,966	83,629	146,457	9,308	7,121	31,955	30
Dietary study No. 376.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Corned (31)	3,629	....	1,928	567	428	....	1,701	500	378	....	47
Boiled (9)	3,969	....	2,835	831	938	....	1,134	332	375	....	29

Beefsteak (26)	3,515	....	2,381	590	655	....	1,134	281	312	....	32
Roast (15)	3,061	....	2,381	545	571	....	680	156	163	....	22
Total	14,174	....	9,525	2,533	2,592	....	4,649	1,269	1,228	....	33
Pork:											
Sausage (62)	2,041	....	1,701	342	941	27	340	68	188	5	17
Shoulder (55)	3,628	....	1,814	310	490	....	1,814	310	490	....	50
Total	5,669	....	3,515	652	1,431	27	2,154	378	678	5	38
Fish:											
Cod, salt (75)	3,176	....	1,021	294	4	....	2,155	620	9	....	68
Haddock (72)	4,763	....	3,062	276	362	58	1,701	153	201	32	36
Total	7,939	....	4,083	570	366	58	3,856	773	210	32	49
Butter (88)	13,948	....	11,425	114	9,711	....	2,523	25	2,145	....	18
Total animal food	41,730	....	28,548	3,869	14,100	85	13,182	2,445	4,261	37	32
VEGETABLE FOOD.											
Cereals:											
Corn-meal mush (98)	2,155	....	2,155	28	9	310	....	....	....	....	....
Hominy (94)	8,845	....	4,082	82	37	776	4,763	95	43	905	54
Oatmeal (113)	4,423	....	2,722	71	33	286	1,701	44	20	179	38
Rice (124)	8,278	....	1,928	23	....	233	6,350	76	....	768	77
Wheat breakfast food (127)	5,216	....	2,381	43	9	326	2,835	51	11	388	54
Wheat breakfast food (128)	4,763	....	2,268	57	9	354	2,495	62	10	389	52
Bread (133)	68,607	2,495	46,267	4,257	601	24,568	19,845	1,826	258	10,538	29
Crackers (131)	3,969	226	2,722	267	248	1,990	1,021	100	93	746	26
Dressing, bread (142)	454	....	454	42	6	241	....	....	....	....	....
Gingerbread (141)	4,536	....	3,629	210	327	2,304	907	53	82	576	20
Cookies, ginger (141)	3,175	....	3,175	184	286	2,016	....	....	....	....	....
Cake (137)	3,629	....	3,629	229	167	2,065	....	....	....	....	....
Total	118,050	2,721	75,412	5,493	1,732	35,469	39,917	2,307	517	14,489	34
Sugar (146)	2,268	....	2,268	....	....	2,268	....	....	....	....	....
Vegetables:											
Beans, kidney (154)	5,443	....	3,515	355	28	942	1,928	195	15	517	35
Beans, baked (152)	8,845	....	8,732	681	690	2,026	113	9	9	26	1
Corn, stewed (179)	3,403	....	2,949	92	94	596	454	14	15	92	13
Potatoes, steamed (207)	19,618	....	9,865	187	10	1,480	9,753	185	10	1,463	50
Soup, bean (239)	31,299	....	14,969	314	30	1,003	16,330	343	33	1,094	52
Soup, vegetable (253)	11,340	....	5,670	40	....	340	5,670	40	....	340	50
Sauce, rhubarb (234)	7,257	....	5,783	29	35	1,336	1,474	7	9	340	20
Turnips, boiled (269)	3,855	....	3,175	48	6	289	680	10	1	62	18
Cabbage, boiled (166)	4,876	....	3,402	65	14	225	1,474	28	6	97	30
Total	95,936	....	58,060	1,811	907	8,237	37,876	831	98	4,031	39

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 376—Continued.											
VEGETABLE FOOD—continued.											
Fruits, etc.:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Jelly, apple (292)	8,618	....	7,711	23	....	5,398	907	3	....	635	11
Sauce, apple (302)	4,309	....	3,742	15	15	1,040	567	2	2	158	13
Sauce, peach, evaporated (307)	7,824	....	5,443	103	22	1,731	2,381	45	10	757	30
Total	20,751	....	16,896	141	37	8,169	3,855	50	12	1,550	....
Total vegetable food	237,005	2,721	152,636	7,445	2,676	54,143	81,648	3,188	627	20,070	34
MISCELLANEOUS FOOD.											
Pudding, cottage (358)	2,608	....	2,608	164	120	1,484	....	....	....	....	....
Hominy and beans (332)	6,350	....	6,350	298	57	1,372	....	....	....	....	....
Liver and bacon (310)	1,928	....	1,474	380	593	12	454	117	182	4	24
Pudding, bread (353)	5,897	....	5,443	142	125	1,203	454	12	10	100	8
Pie, evaporated apple (345)	5,443	....	5,443	169	533	2,330	....	....	....	....	....
Stew, beef (316)	16,216	....	11,907	1,179	1,095	833	4,309	427	396	302	27
Sauce, pudding (370)	3,629	....	3,629	33	171	508	....	....	....	....	....
Total	42,071	....	36,854	2,365	2,694	7,742	5,217	556	588	406	12
Total food	320,806	2,721	218,038	13,679	19,470	61,970	100,047	6,189	5,476	20,513	31
Dietary study No. 377.											
ANIMAL FOOD.											
Beef:											
Boiled (9)	6,464	....	4,536	1,329	1,501	....	1,928	565	638	....	30
Corned (31)	6,124	....	4,536	1,334	1,007	....	1,588	467	353	....	26
Roast (15)	4,763	....	3,402	779	817	....	1,361	312	327	....	29
Steak (26)	4,309	....	3,515	872	967	....	794	197	218	....	18
Total	21,660	....	15,989	4,314	4,292	....	5,671	1,541	1,536	....	26
Pork:											
Sausage, fried (62)	3,402	....	3,402	684	1,881	54	....	....	....	....	....
Shoulder, boiled (55)	5,783	....	3,288	563	887	....	2,495	427	674	....	43
Total	9,185	....	6,690	1,247	2,768	54	2,495	427	674	....	27

Fish:											
Cod, salt, boiled (75)	4,196	....	2,495	719	10	....	1,701	490	7	....	40
Haddock, baked (72)	5,443	....	3,175	286	375	60	2,268	204	268	43	42
Total	9,639	....	5,670	1,005	385	60	3,969	694	275	43	41
Butter (88)	21,092	....	19,958	200	16,964	....	1,134	11	964	....	5
Total animal food	61,576	....	48,307	6,766	24,409	114	13,269	2,673	3,449	43	22
VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	108,410	....	89,699	8,252	1,166	47,630	18,711	1,721	243	9,936	17
Cake (137)	4,990	....	4,990	314	230	2,839	....	....	....	....	....
Crackers, (134)	4,763	....	4,763	467	433	3,482	....	....	....	....	....
Gingerbread (141)	6,804	....	6,804	395	612	4,320	....	....	....	....	....
Ginger cookies (141)	3,629	....	3,175	184	286	2,016	454	26	41	288	13
Hominy (94)	11,113	....	5,670	113	51	1,077	5,443	109	49	1,034	49
Dressing, bread (142)	454	....	454	42	6	241	....	....	....	....	....
Mush, fried (98)	2,835	....	2,835	37	11	408	....	....	....	....	....
Oatmeal (113)	6,010	....	3,515	91	42	369	2,495	65	30	262	42
Rice, boiled (124)	11,793	....	4,649	56	....	562	7,144	86	....	864	61
Wheat breakfast food (128)	5,217	....	3,856	96	15	602	1,361	34	5	212	26
Wheat breakfast food (127)	6,350	....	1,814	33	7	249	4,536	82	18	621	71
Total	172,368	....	132,224	10,080	2,859	63,795	40,144	2,123	386	13,217	23
Sugar (146)	2,268	....	2,268	....	....	2,268	....	....	....	....	....
Vegetables:											
Beans, baked (152)	12,021	....	10,433	814	824	2,420	1,588	124	125	368	13
Beans, kidney, boiled (154)	6,577	....	5,330	538	43	1,429	1,247	126	10	334	19
Cabbage, boiled (166)	7,484	....	5,216	99	21	344	2,268	43	9	150	30
Corn, stewed (179)	3,742	....	3,742	116	120	756	....	....	....	....	....
Potatoes, steamed (207)	26,422	....	19,051	362	19	2,858	7,371	140	7	1,106	28
Sauce, rhubarb (234)	8,845	....	6,691	33	40	1,546	2,154	11	13	498	24
Soup, bean (239)	66,225	....	51,710	1,086	103	3,465	14,515	305	29	973	22
Soup, vegetable (253)	19,958	....	13,381	94	....	803	6,577	46	....	395	33
Turnips, boiled (269)	4,536	....	4,082	61	8	371	454	7	1	41	10
Total	155,810	....	119,636	3,203	1,178	13,992	36,174	802	194	3,865	23
Fruits, etc.:											
Jelly, apple (292)	9,185	....	7,144	21	....	5,001	2,041	6	....	1,429	22
Sauce, apple (302)	5,331	....	4,310	17	17	1,198	1,021	4	4	284	19
Sauce, peach, evaporated (307)	10,886	....	7,711	147	30	2,452	3,175	60	13	1,010	29
Total	25,402	....	19,165	185	47	8,651	6,237	70	17	2,723	25
Total vegetable food	355,848	....	273,293	13,468	4,084	88,706	82,555	2,995	597	19,805	23

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 377—Continued.											
MISCELLANEOUS FOOD.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Pudding, cottage (358)	2,948		2,948	186	136	1,678					
Hominy and beans (332)	7,257		1,814	85	16	392	5,443	256	49	1,176	75
Liver and bacon (310)	3,402		3,062	790	1,231	25	340	88	137	3	10
Pie, apple, evaporated (345)	7,484		7,484	232	734	3,203					
Pudding, bread (353)	6,577		6,577	171	151	1,454					
Sauce for pudding (370)	1,814		1,814	16	85	254					
Stew, beef (216)	23,473		18,824	1,864	1,732	1,318	4,649	460	428	325	20
Total	52,955		42,523	3,344	4,085	8,324	10,432	804	614	1,504	20
Total food	470,379		364,123	23,578	32,578	97,144	106,256	6,472	4,660	21,352	23
Dietary study No. 378.											
ANIMAL FOOD.											
Beef:											
Corned (31)	3,062		2,608	767	579		454	133	101		15
Steak (26)	2,948	1,360	1,134	281	312		454	113	125		15
Boiled (9)	2,948	1,361	1,247	365	413		340	100	113		12
Roast (17)	2,268	1,814					454	108	114		20
Total	11,226	4,535	4,989	1,413	1,304		1,702	454	453		15
Pork:											
Sausage (62)	1,814		1,474	296	815	24	340	68	188	5	19
Shoulder (55)	3,402	907	2,041	349	551		454	78	123		13
Total	5,216	907	3,515	645	1,366	24	794	146	311	5	15
Fish:											
Herring, fresh (73)	6,011		5,217	1,414	1,487	318	794	215	226	48	13
Mackerel, salt (80)	1,814		1,474	386	413		340	90	95		19
Total	7,825		6,691	1,800	1,900	318	1,134	305	321	48	14
Butter (88)	5,443		4,054	41	3,446		1,389	14	1,181		26
Total animal food	29,710	5,442	19,249	3,899	8,016	342	5,019	919	2,266	53	17

VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	60,953	9,639	43,149	3,970	561	22,912	8,165	751	106	4,336	13
Crackers (134)	2,268		2,268	222	207	1,658					
Wheat breakfast food (127)	3,402		3,062	55	12	420	340	6	1	47	10
Macaroni (143)	4,082		3,515	116	74	555	567	19	12	90	14
Oatmeal (113)	3,175		2,495	65	30	262	680	18	8	71	21
Rice (124)	9,752	4,535	5,217	63		631					
Gingerbread (141)	6,502	1,474	4,801	279	433	3,049	227	13	20	144	3
Mush (98)	3,175		2,041	27	8	294	1,134	15	5	163	36
Hominy (94)	6,917		4,195	84	38	797	2,722	54	24	517	39
Wheat breakfast food (28)	3,402		2,835	71	11	442	567	14	2	88	17
Cake (137)	2,949		2,949	186	136	1,678					
Total	106,577	15,648	76,527	5,138	1,510	32,698	14,402	890	178	5,456	14
Sugar (146)	4,763		4,763			4,763					
Vegetables:											
Sauce, rhubarb (234)	3,629		3,062	15	18	707	567	3	3	131	16
Soup, bean (239)	42,638		24,381	512	49	1,634	18,257	383	37	1,223	43
Soup, vegetable (253)	13,608		9,866	69		592	3,742	26		225	28
Potatoes, steamed (207)	21,999	907	16,216	308	16	2,432	4,876	93	5	731	22
Onions, boiled (184)	3,856		2,495	30	45	122	1,361	16	25	67	35
Beans, baked (152)	7,485		5,217	407	412	1,210	2,268	177	179	526	30
Pickles, cucumber (190)	2,268		1,814	9	5	49	454	2	1	12	20
Turnips, boiled (269)	3,629		3,629	54	7	330					
Tomatoes, stewed (268)	3,515		2,608	42	37	329	907	15	13	114	26
Total	102,627	907	69,288	1,446	589	7,405	32,432	715	263	3,029	32
Fruits, etc.:											
Apples, fresh (271)	16,896		16,896	51	51	1,825					
Sauce, apple (300)	3,402		2,722	11	14	825	680	3	3	206	20
Sauce, peach (307)	7,371		4,309	82	17	1,370	3,062	58	12	974	42
Jelly, apple (292)	3,628		2,381	7		1,667	1,247	4		873	34
Prunes, stewed (291)	3,969		3,402	27		1,391	567	5		232	14
Total	35,266		29,710	178	82	7,078	5,556	70	15	2,285	16
Total vegetable food	249,233	16,555	180,288	6,762	2,181	51,944	52,390	1,675	456	10,770	21
MISCELLANEOUS FOOD.											
Liver and bacon (310)	1,815		1,758	454	707	14	57	15	23	1	3
Stew, beef (316)	11,226	1,474	8,845	876	814	619	907	90	83	64	8
Pudding, bread (353)	6,124		6,124	159	141	1,353					
Total	19,165	1,474	16,727	1,489	1,662	1,986	964	105	106	65	5
Total food	298,108	23,471	216,264	12,150	11,859	54,272	58,373	2,699	2,828	10,888	20

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 379.											
ANIMAL FOOD.											
Beef:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Corned (31)	6,463	1,814	3,742	1,100	831		907	267	201		14
Steak (26)	3,855		3,288	815	904		567	141	156		15
Boiled (9)	6,577	1,814	4,763	1,396	1,577						
Roast (17)	4,309		4,309	1,026	1,077						
Total	21,204	3,628	16,102	4,337	4,389		1,474	408	357		7
Pork:											
Sausage (62)	3,402		3,402	684	1,881	54					
Shoulder (55)	4,423		1,928	330	521		2,495	427	674		56
Total	7,825		5,330	1,014	2,402	54	2,495	427	674		32
Fish:											
Herring, fresh (73)	18,938		17,067	4,625	4,864	1,041	1,871	507	533	114	10
Mackerel, salt (80)	3,289		2,835	743	794		454	119	127		14
Total	22,227		19,902	5,368	5,658	1,041	2,325	626	660	114	10
Butter (88)	10,886		10,886	109	9,253						
Total animal food	62,142	3,628	52,220	10,828	21,702	1,095	6,294	1,461	1,691	114	10
VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	117,767	5,330	102,713	9,450	1,335	54,541	9,724	895	126	5,163	8
Crackers (134)	3,856		3,856	378	351	2,819					
Wheat breakfast food (127)	5,443		4,082	73	16	559	1,361	24	5	186	25
Macaroni (143)	6,917	2,268	3,742	123	79	591	907	30	19	143	13
Oatmeal (113)	4,536		3,402	88	41	357	1,134	29	14	119	25
Rice (124)	15,196	10,093	5,103	61		617					
Gingerbread (141)	8,845		8,703	505	783	5,526	142	8	13	90	2
Mush (98)	3,629		3,175	41	13	457	454	6	2	65	13
Hominy (94)	8,732	3,289	3,515	70	32	668	1,928	39	17	366	22

Wheat breakfast food (128)	4,876	....	3,515	88	14	548	1,361	31	5	212	28
Cake (137)	2,949	....	2,949	186	136	1,678	....	....	....	....	....
Total	182,746	20,980	144,755	11,063	2,800	68,361	17,011	1,065	201	6,344	9
Sugar (146)	1,701	....	1,701	....	....	1,701	....	....	....	....	....
Vegetables:											
Sauce, rhubarb (234)	4,536	....	4,309	22	26	995	227	1	1	52	5
Soup, bean (239)	78,926	....	53,865	1,131	108	3,609	25,061	526	50	1,680	32
Soup, vegetable (253)	27,216	....	22,226	156	....	1,334	4,990	35	....	299	18
Potatoes, steamed (207)	28,917	794	26,082	496	26	3,912	2,041	39	2	306	7
Onions, boiled (184)	6,124	....	6,124	73	110	300	....	....	....	....	....
Beans, baked (152)	12,247	....	11,453	893	905	2,657	794	62	63	184	6
Pickles, cucumber (190)	2,268	....	2,268	11	7	61	....	....	....	....	....
Turnips (269)	5,443	....	5,443	82	11	495	....	....	....	....	....
Tomatoes, stewed (268)	5,443	....	4,309	69	60	543	1,134	18	16	143	21
Total	171,120	794	136,079	2,933	1,253	13,906	34,247	681	132	2,664	20
Fruits, etc.:											
Apples, fresh (271)	26,876	....	26,876	81	81	2,903	....	....	....	....	....
Sauce, apple (300)	4,649	....	4,649	19	23	1,409	....	....	....	....	....
Sauce, peach (307)	10,433	....	9,412	179	38	2,993	1,021	19	4	325	10
Jelly, apple (292)	4,536	....	3,969	12	....	2,778	567	2	....	397	13
Prunes, stewed (291)	5,216	....	4,536	36	....	1,855	680	5	....	278	13
Total	51,710	....	49,442	327	142	11,938	2,268	26	4	1,000	4
Total vegetable food	407,277	21,774	331,977	14,323	4,195	95,906	53,526	1,772	337	10,008	13
MISCELLANEOUS FOOD.											
Liver and bacon (310)	3,062	....	3,062	790	1,231	24	....	....	....	....	....
Stew, beef (316)	17,463	....	15,649	1,549	1,440	1,095	1,814	180	167	127	10
Pudding, bread (353)	9,526	....	9,526	248	219	2,105	....	....	....	....	....
Total	30,051	....	28,237	2,587	2,890	3,224	1,814	180	167	127	6
Total food	499,470	25,402	412,434	27,738	28,787	100,225	61,634	3,413	2,195	10,249	12
Dietary study No. 380.											
ANIMAL FOOD.											
Beef:											
Corned (31)	6,577	2,608	3,289	967	730	....	680	200	151	....	10
Steak (26)	4,763	....	3,856	956	1,060	....	907	225	249	....	19
Boiled (9)	6,463	3,741	2,722	798	901	....	....	....	....	....	....
Roast (17)	4,763	....	4,536	1,080	1,134	....	227	54	57	....	5
Total	22,566	6,349	14,403	3,801	3,825	....	1,814	479	457	....	8

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 380—Continued.											
ANIMAL FOOD—continued.											
Pork:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Sausage (62)	3,629	567	3,062	615	1,693	49					
Shoulder (55)	6,237	2,722	3,515	601	949						
Total	9,866	3,289	6,577	1,216	2,642	49					
Fish:											
Herring, fresh (73)	16,103		12,928	3,503	3,683	789	3,175	860	905	194	20
Mackerel, salt (80)	3,855	2,041	1,814	475	508						
Total	19,958	2,041	14,742	3,978	4,191	789	3,175	860	905	194	16
Butter (88)	10,887		10,490	105	8,917		397	4	337		4
Total animal food	63,277	11,679	46,212	9,100	19,575	838	5,386	1,343	1,699	194	9
VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	116,972	15,989	96,787	8,904	1,258	51,394	4,196	386	55	2,228	4
Crackers (134)	4,309	453	3,771	370	343	2,757	85	8	8	62	2
Wheat breakfast food (127)	4,990		3,402	61	14	466	1,588	29	6	218	32
Macaroni (143)	6,690	1,360	5,330	176	112	842					
Oatmeal (113)	5,897	2,041	3,856	100	46	405					
Rice (124)	18,371	11,567	6,804	82		823					
Gingerbread (141)	8,845	680	8,165	474	735	5,185					
Mush (98)	4,989		3,175	41	13	457	1,814	24	7	261	36
Hominy (94)	9,639	3,175	3,969	79	36	754	2,495	50	22	474	26
Wheat breakfast food (128)	4,536		3,175	79	13	495	1,361	34	5	212	30
Cake (137)	3,175		3,175	200	146	1,807					
Total	188,413	35,265	141,609	10,566	2,716	65,385	11,539	531	103	3,455	6
Sugar (146)	2,646		2,646			2,646					
Vegetables:											
Rhubarb sauce (234)	4,877		3,856	19	23	891	1,021	5	6	236	21
Soup, bean (239)	83,463		53,525	1,124	107	3,586	29,938	629	60	2,006	36

Soup, vegetable (253)	27,216	....	15,422	108	....	925	11,794	83	....	708	43
Potatoes, steamed (207)	30,051	11,226	17,974	342	18	2,696	851	16	1	127	3
Onions, boiled (184)	5,103	....	3,742	45	67	183	1,361	16	25	67	27
Beans, baked (152)	11,907	....	10,206	796	806	2,368	1,701	133	134	395	14
Pickles, cucumber (190)	2,268	....	2,268	11	7	61	....	....	....	....	....
Turnips, boiled (269)	5,443	2,268	3,175	48	6	289	....	....	....	....	....
Tomatoes, stewed (268)	5,783	....	4,422	71	62	557	1,361	22	19	171	24
Total	176,111	13,494	114,590	2,564	1,096	11,556	48,027	904	245	3,710	27
Fruits, etc.:											
Apples (271)	29,030	....	29,030	87	87	3,135	....	....	....	....	....
Sauce, apple (300)	5,103	....	4,309	17	22	1,306	794	3	4	241	16
Sauce, peach (307)	11,567	....	8,845	168	35	2,813	2,722	52	11	866	24
Jelly, apple (292)	4,990	....	3,969	12	....	2,778	1,021	3	....	715	20
Prunes, stewed (291)	5,443	....	4,196	34	....	1,716	1,247	10	....	510	23
Total	56,133	....	50,349	318	144	11,748	5,784	68	15	2,332	10
Total vegetable food	423,305	48,759	309,194	13,448	3,956	91,335	65,350	1,503	363	9,497	15
MISCELLANEOUS FOOD.											
Liver and bacon (310)	3,516	....	3,062	790	1,231	24	454	117	183	4	13
Stew, beef (316)	18,030	2,267	14,969	1,480	1,377	1,048	794	79	73	56	4
Pudding, bread (353)	9,526	....	9,526	248	219	2,105	....	....	....	....	....
Total	31,072	2,267	27,557	2,518	2,827	3,177	1,248	196	256	60	4
Total food	517,652	62,705	382,963	25,066	26,358	95,350	71,984	3,042	2,318	9,751	14
Dietary study No. 381.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Boiled (9)	5,216	1,814	2,722	798	901	....	680	199	225	....	13
Beefsteak (26)	3,402	....	3,402	844	936	....	....	....	....	....	....
Corned (28)	3,969	....	3,515	805	608	....	454	104	79	....	11
Roast (14)	6,124	....	5,217	1,080	1,137	....	907	188	198	....	15
Total	18,711	1,814	14,856	3,527	3,582	....	2,041	491	502	....	11
Pork:											
Ham (53)	2,722	681	1,361	289	400	....	680	144	200	....	25
Sausage (62)	2,495	....	2,268	456	1,254	36	227	46	126	4	9
Shoulder (55)	3,969	....	3,515	601	949	....	454	78	123	....	11
Total	9,186	681	7,144	1,346	2,603	36	1,361	268	449	4	15

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 381—Continued.											
ANIMAL FOOD—continued.											
Fish:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Herring (73)	4,649	....	4,649	1,260	1,325	284	....	....	....	....	....
Mackerel (80)	3,175	....	2,268	594	635	....	907	238	254	....	28
Shad (74)	3,969	....	3,289	296	388	62	680	61	80	13	17
Total	11,793	....	10,206	2,150	2,348	346	1,587	299	331	13	13
Butter (88)	7,711	....	7,711	77	6,554	....	....	....	....	....	....
Milk (91)	27,216	....	27,216	895	1,089	1,361	....	....	....	....	....
Total animal food	74,617	2,495	67,133	7,995	16,176	1,743	4,989	1,058	1,285	17	7
VEGETABLE FOOD.											
Cereals:											
Corn-meal mush (98)	3,742	....	3,175	41	13	457	567	7	2	82	15
Hominy (94)	7,598	2,722	4,876	98	44	926	....	....	....	....	....
Oatmeal (113)	7,938	....	7,371	192	88	774	567	15	7	60	7
Rice (124)	12,587	5,670	5,783	69	....	700	1,134	14	....	137	9
Wheat breakfast food (128)	4,082	....	4,082	102	16	637	....	....	....	....	....
Bread (133)	64,411	1,814	58,004	5,336	754	30,800	4,593	423	60	2,439	7
Cake (137)	2,268	....	2,268	143	104	1,290	....	....	....	....	....
Crackers (134)	2,608	....	2,608	256	237	1,906	....	....	....	....	....
Doughnuts (140)	2,495	....	2,495	167	524	1,325	....	....	....	....	....
Gingerbread (141)	6,351	....	5,897	342	531	3,745	454	26	41	288	7
Macaroni (143)	5,103	....	4,196	138	88	663	907	30	19	143	18
Total	119,183	10,206	100,755	6,884	2,399	43,223	8,222	515	129	3,149	7
Sugar (146)	3,402	....	3,402	....	....	3,402	....	....	....	....	....
Vegetables:											
Beans, baked (150)	4,536	567	3,969	385	254	1,000	....	....	....	....	....
Beans, baked (151)	5,443	1,360	3,856	343	228	1,018	227	20	13	59	4
Beans, Lima (155)	9,979	907	8,618	483	43	1,775	454	25	2	94	5
Corn (179)	4,196	....	4,196	130	134	848	....	....	....	....	....
Kale (181)	11,567	....	11,567	162	440	578	....	....	....	....	....
Potatoes, steamed (207)	19,732	5,443	14,289	271	14	2,143	....	....	....	....	....

Soup, bean (239)	40,824	....	37,649	791	75	2,522	3,175	67	6	212	8
Soup, vegetable (253)	13,608	....	12,928	90	....	776	680	5	....	41	5
Total	109,885	8,277	97,072	2,655	1,188	10,660	4,536	117	21	406	4
Fruits, etc.:											
Jelly, apple (292)	3,629	2,495	1,134	3	....	794	....	....	....	....	....
Prunes, stewed (291)	8,164	1,814	5,443	44	....	2,226	907	7	....	371	11
Sauce, apple (300)	9,299	1,361	6,577	26	33	1,993	1,361	5	7	412	15
Sauce, peach (307)	3,742	2,495	1,247	24	5	397	....	....	....	....	....
Total	24,834	8,165	14,401	97	38	5,410	2,268	12	7	783	9
Total vegetable food	257,304	26,648	215,630	9,636	3,625	62,695	15,026	614	157	4,338	6
MISCELLANEOUS FOOD.											
Hash (309)	15,082	....	12,814	1,499	3,075	1,243	2,268	265	544	220	15
Liver and bacon (310)	5,330	1,020	3,856	995	1,550	31	454	117	183	4	9
Pudding, bread (353)	2,835	....	2,041	53	47	451	794	21	18	175	28
Pudding, cottage (358)	2,268	....	2,268	143	104	1,290	....	....	....	....	....
Pie, evaporated-apple (345)	4,536	....	4,536	141	445	1,941	....	....	....	....	....
Sauce for pudding (370)	1,361	....	1,361	12	64	191	....	....	....	....	....
Stew, beef (316)	27,783	2,948	20,866	2,066	1,920	1,461	3,969	393	365	278	14
Total	59,195	3,968	47,712	4,909	7,205	6,608	7,485	796	1,110	677	13
Total food	391,116	33,111	330,505	22,540	27,006	71,046	27,500	2,498	2,552	5,032	7
Dietary study No. 382.											
ANIMAL FOOD.											
Beef:											
Boiled (9)	4,763	2,268	2,155	631	713	....	340	100	113	....	7
Corned (28)	4,309	2,835	1,134	260	196	....	340	78	59	....	8
Roast (14)	5,670	2,721	2,495	516	544	....	454	94	99	....	8
Steak (26)	3,402	....	3,175	787	873	....	227	56	63	....	7
Total	18,144	7,824	8,959	2,194	2,326	....	1,361	328	334	....	8
Pork:											
Ham, fried (53)	1,814	....	1,247	264	367	....	567	120	164	....	31
Sausage (62)	2,722	340	2,155	433	1,192	34	227	46	126	4	8
Shoulder, boiled (55)	4,309	2,268	1,701	291	459	....	340	58	92	....	8
Total	8,845	2,608	5,103	988	2,018	34	1,134	224	382	4	13
Fish:											
Herring, fresh, fried (73)	4,082	....	4,082	1,106	1,163	249	....	....	....	....	....
Mackerel, salt (80)	3,175	....	2,268	594	635	....	907	238	254	....	29
Shad, fresh, baked (74)	4,536	....	2,495	225	294	47	2,041	184	241	39	45
Total	11,793	....	8,845	1,925	2,092	296	2,948	422	495	39	25

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 382—Continued.											
ANIMAL FOOD—continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Butter (88)	7, 711		7, 711	77	6, 554						
Milk (91)	27, 216		27, 216	898	1, 089	1, 361					
Total animal food	73, 709	10. 432	57, 834	6, 082	14, 079	1, 691	5, 443	974	1, 211	43	7
VEGETABLE FOOD.											
Cereals:											
Bread, biscuit, etc. (133)	64, 865	2, 268	58, 061	5, 342	755	30, 830	4, 536	417	59	2, 409	7
Cake (137)	2, 268		2, 268	143	104	1, 290					
Crackers (134)	2, 268		2, 268	222	206	1, 658					
Doughnuts (140)	2, 495		2, 495	167	524	1, 325					
Gingerbread (141)	6, 124	1, 021	5, 103	296	459	3, 240					
Hominy (94)	7, 597		6, 690	134	60	1, 271	907	18	8	172	12
Macaroni, boiled (143)	5, 216		4, 536	150	95	717	680	22	14	107	13
Mush, cornmeal (98)	3, 969		2, 608	34	10	376	1, 361	18	5	196	34
Oatmeal (113)	8, 278		8, 278	215	99	869					
Rice, boiled (124)	13, 835	5, 330	8, 165	98		988	340	4		41	2
Wheat breakfast food (128)	4, 082	1, 701	2, 381	60	10	371					
Total	120, 997	10, 320	102, 853	6, 861	2, 322	42, 935	7, 824	479	86	2, 925	6
Sugar (146)	4, 536		4, 536			4, 536					
Vegetables:											
Beans, baked (150)	4, 876	567	4, 309	418	276	1, 086					
Beans, baked (151)	4, 989	1, 474	3, 402	303	201	898	113	10	7	30	2
Beans, Lima (155)	10, 319	3, 855	6, 237	349	31	1, 285	227	13	1	47	2
Corn, stewed (179)	5, 443		5, 443	169	174	1, 099					
Kale, boiled (181)	8, 618		8, 618	121	327	431					
Soup, bean (239)	40, 824		40, 824	857	82	2, 735					
Soup, vegetable (253)	13, 608		13, 608	95		816					
Potatoes, steamed (207)	20, 071	6, 803	13, 268	252	13	1, 990					
Total	108, 748	12, 699	95, 709	2, 564	1, 104	10, 340	340	23	8	77	

Fruits, etc.:											
Jelly, apple (292)	3,629	2,155	1,474	4	...	1,032	...	...	...	...	...
Prunes, stewed (291)	7,372	1,021	5,217	42	...	2,134	1,134	9	...	464	15
Sauce, apple, evaporated (300)	9,072	1,361	6,690	27	33	2,027	1,021	4	5	309	11
Sauce, peach, evaporated (307)	4,082	2,494	1,588	30	6	505	...	...	...	...	...
Total	24,155	7,031	14,969	103	39	5,698	2,155	13	5	773	9
Total vegetable food	258,436	30,050	218,067	9,528	3,465	63,509	10,319	515	99	3,775	4
MISCELLANEOUS FOOD.											
Hash (309)	16,216	...	13,041	1,526	3,130	1,265	3,175	371	762	308	20
Liver and bacon (310)	4,762	453	3,175	819	1,276	25	1,134	293	456	9	24
Pie, apple, evaporated (345)	4,536	...	4,536	141	445	1,941	...	...	...	...	...
Pudding, bread (353)	2,835	...	2,835	74	65	627	...	...	...	...	...
Pudding, cottage (358)	1,928	...	1,928	121	89	1,097	...	...	...	...	...
Sauce for pudding (370)	1,361	...	1,361	12	64	191	...	...	...	...	...
Stew, beef (316)	27,330	2,722	20,072	1,987	1,847	1,405	4,536	449	417	318	17
Total	58,968	3,175	46,948	4,680	6,916	6,551	8,845	1,113	1,635	635	15
Total food	391,113	43,657	322,849	20,290	24,460	71,751	24,607	2,602	2,945	4,453	6
Dietary study No. 383.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Boiled (9)	4,082	1,700	2,155	631	713	...	227	67	75	...	6
Beefsteak (26)	2,608	...	1,928	478	530	...	680	169	187	...	26
Corned (28)	3,289	1,814	1,021	234	177	...	454	104	79	...	14
Roast (14)	5,217	2,608	2,155	446	470	...	454	94	99	...	9
Total	15,196	6,122	7,259	1,789	1,890	...	1,815	434	440	...	12
Pork:											
Sausage (62)	2,722	...	2,722	547	1,505	44	...	...	...	...	...
Shoulder (55)	3,742	1,927	1,361	233	367	...	454	78	123	...	12
Total	6,464	1,927	4,083	780	1,872	44	454	78	123	...	7
Fish:											
Herring (73)	7,144	1,474	5,670	1,537	1,616	346	...	...	...	...	...
Mackerel (80)	2,495	...	2,041	535	571	...	454	119	127	...	18
Total	9,639	1,474	7,711	2,072	2,187	346	454	119	127	...	5
Butter (88)	7,710	...	5,471	55	4,650	...	2,239	22	1,903	...	29
Milk (91)	27,216	...	27,216	898	1,089	1,361	...	...	...	...	...
Total animal food	66,225	9,523	51,740	5,594	11,688	1,751	4,962	653	2,593	...	7

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 383—Continued.											
VEGETABLE FOOD.											
Cereals:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Corn-meal mush (98)	2,949		2,155	28	9	310	794	10	3	114	27
Hominy (94)	6,804	907	5,840	117	53	1,110	57	1	1	11	1
Oatmeal (113)	8,165	1,701	6,464	168	78	679					
Rice (124)	13,268	10,546	2,722	33		329					
Wheat breakfast food (128)	3,403		2,949	74	12	460	454	11	2	71	13
Bread (133)	63,788	794	55,509	5,107	722	29,475	7,485	689	97	3,975	12
Cake (127)	2,268		2,268	143	104	1,290					
Crackers (134)	2,155		2,155	211	196	1,575					
Doughnuts (140)	2,381		2,381	160	500	1,264					
Gingerbread (141)	5,897	1,021	4,649	270	418	2,952	227	13	20	144	4
Macaroni (143)	4,649	2,268	2,381	79	50	376					
Total	115,727	17,237	89,473	6,390	2,142	39,820	9,017	724	123	4,315	8
Sugar (146)	3,402		3,402			3,402					
Vegetables:											
Beans, baked (150)	3,743		3,289	319	210	829	454	44	29	114	12
Beans, baked (151)	4,763	1,814	2,949	262	174	779					
Beans, Lima (155)	8,731	1,814	5,783	324	29	1,191	1,134	64	6	234	13
Corn (179)	4,763	1,814	2,949	91	94	596					
Kale (181)	7,485		7,031	98	267	351	454	6	17	23	6
Potatoes, steamed (207)	18,938	12,134	6,804	129	7	1,021					
Soup, bean (239)	40,824		37,195	781	74	2,492	3,629	76	7	243	9
Soup, vegetable (253)	13,608		13,608	95		816					
Total	102,855	17,576	79,608	2,099	855	8,075	5,671	190	59	614	6
Fruits, etc.:											
Jelly, apple (292)	3,288	1,814	1,474	4		1,032					
Prunes, stewed (291)	6,237		6,010	48		2,458	227	2		93	4
Sauce, apple (300)	8,505		8,165	33	41	2,474	340	1	2	103	4
Sauce, peach (307)	4,195	1,927	2,041	39	8	649	227	4	1	72	5
Total	22,225	3,741	17,690	124	49	6,613	794	7	3	268	4
Total vegetable food	244,209	38,554	190,173	8,613	3,046	57,910	15,482	921	185	5,197	6

MISCELLANEOUS FOOD.											
Liver and bacon (310)	2,608	907	1,701	439	684	14					
Pie, evaporated-apple (345)	4,536		4,536	141	445	1,941					
Pudding, bread (353)	2,835		1,588	41	37	351	1,247	32	29	276	44
Pudding, cottage (358)	1,928		1,928	121	89	1,097					
Sauce for pudding (370)	1,361		1,361	12	64	191					
Stew, beef (316)	12,134	1,814	9,299	921	856	651	1,021	101	94	71	8
Total	25,402	2,721	20,413	1,675	2,175	4,245	2,268	133	123	347	9
Total food	335,836	50,798	262,326	15,882	16,909	63,906	22,712	1,707	2,901	5,544	7
Dietary study No. 384.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Boiled (9)	4,536	1,474	2,155	631	713		907	266	300		20
Beefsteak (26)	3,175	907	1,928	478	530		310	84	94		11
Corned (31)	4,536	2,268	1,814	533	403		454	133	101		10
Roast (14)	4,763	2,722	2,041	422	415						
Total	17,010	7,371	7,938	2,064	2,091		1,701	483	495		10
Pork:											
Sausage (62)	3,062		3,062	615	1,693	49					
Shoulder (57)	4,990	2,722	2,041	416	553		227	46	62		5
Total	8,052	2,722	5,103	1,031	2,246	49	227	46	62		3
Fish:											
Herring (73)	7,938	2,721	3,856	1,045	1,099	235	1,361	369	388	83	17
Mackerel (80)	2,835	1,247	1,134	297	318		454	119	127		16
Total	10,773	3,968	4,990	1,342	1,417	235	1,815	488	515	83	17
Butter (88)	7,711		7,711	77	6,554						
Total animal food	43,546	14,061	25,742	4,514	12,308	284	3,743	1,017	1,072	83	9
VEGETABLE FOOD.											
Cereals:											
Hominy (94)	10,433	5,443	3,062	61	28	582	1,928	39	17	366	18
Oatmeal (113)	9,753	1,361	7,485	195	99	786	907	24	11	95	9
Rice (124)	12,360	9,752	2,608	31		316					
Wheat breakfast food (127)	4,989	340	2,835	51	11	388	1,814	33	7	249	36
Wheat breakfast food (128)	4,876		2,835	71	11	412	2,041	51	8	318	42
Bread (133)	90,153	2,495	75,298	6,927	979	39,983	12,360	1,137	161	6,563	14
Cake (137)	2,494		1,814	114	83	1,032	680	43	31	387	27
Crackers (134)	4,083		3,356	378	351	2,819	227	22	21	166	6
Gingerbread and cakes (141)	5,897		4,990	289	449	3,169	907	53	82	576	15
Total	145,038	19,391	104,783	8,117	2,002	49,517	20,864	1,402	338	8,720	14
Sugar (146)	2,268		2,268			2,268					

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 384—Continued.											
VEGETABLE FOOD—continued.											
Vegetables:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Beans, kidney (153)	11,000	7,031	3,515	250	21	664	454	32	3	86	4
Beans, baked (150)	5,330	2,041	3,289	319	210	828	......	......	......	......	......
Beans, baked (151)	5,330	3,288	1,588	141	94	419	454	40	27	120	9
Cabbage (166)	4,990	......	4,536	86	18	299	454	9	2	30	9
Kale (181)	3,629	......	3,175	44	121	159	454	6	17	23	13
Pickles, cucumber (190)	3,062	......	2,608	13	8	70	454	2	1	12	15
Potatoes, steamed (207)	28,917	14,289	12,360	235	12	1,854	2,268	43	2	340	8
Soup, bean (239)	68,040	......	65,318	1,372	131	4,376	2,722	57	5	182	4
Soup, vegetable (253)	22,681	......	21,093	148	......	1,266	1,588	11	......	95	7
Sauce, rhubarb (234)	4,422	1,473	2,949	15	18	681	......	......	......	......	......
Tomatoes (268)	4,423	2,268	1,361	22	19	171	794	13	11	100	18
Total	161,824	30,390	121,792	2,645	652	10,787	9,642	213	68	988	6
Fruits, etc.:											
Jelly, apple (292)	7,711	3,402	3,175	10	......	2,223	1,134	3	......	794	15
Sauce, apple (300)	4,195	1,587	2,268	9	11	687	340	1	2	103	8
Sauce, peach (307)	11,226	6,009	4,990	95	20	1,587	227	4	1	72	2
Sauce, prune (291)	12,134	4,763	6,917	55	......	2,829	454	4	......	186	4
Total	35,266	15,761	17,350	169	31	7,326	2,155	12	3	1,155	6
Total vegetable food	344,396	65,542	246,193	10,931	2,685	69,898	32,661	1,627	409	10,863	9
MISCELLANEOUS FOOD.											
Macaroni and tomato (334)	5,217	2,268	2,949	103	15	566	......	......	......	......	......
Pie, evaporated-peach (349)	6,804	......	6,804	231	1,198	2,620	......	......	......	......	......
Pie, evaporated-apple (345)	5,103	......	4,649	144	456	1,990	454	14	44	194	9
Pudding, bread (353)	8,732	680	5,103	133	117	1,128	2,949	77	68	652	34
Stew, beef (316)	15,195	6,690	7,258	719	668	508	1,247	123	115	87	8
Total	41,051	9,638	26,763	1,330	2,454	6,812	4,650	214	227	933	11
Total food	428,993	89,241	298,698	16,775	17,447	76,994	41,054	2,858	1,708	11,879	10

Dietary study No. 385.

ANIMAL FOOD.											
Beef, veal, and mutton:											
Boiled (9)	4,309	....	4,082	1,196	1,351	....	227	67	75	....	5
Beefsteak (26)	3,289	....	3,062	759	842	....	227	56	62	....	7
Corned (31)	4,536	....	4,536	1,333	1,007	....	....	....	....	....	....
Roast (14)	3,856	....	3,856	798	841	....	....	....	....	....	....
Total	15,990	....	15,536	4,086	4,041	....	454	123	137	....	3
Pork:											
Sausage (62)	2,949	....	2,949	593	1,631	47	....	....	....	....	....
Shoulder (57)	4,536	1,814	2,722	555	738	....	....	....	....	....	....
Total	7,485	1,814	5,671	1,148	2,369	47	....	....	....	....	....
Fish:											
Herring (73)	7,824	....	7,824	2,120	2,230	477	....	....	....	....	....
Mackerel (80)	2,949	....	2,949	773	826	....	....	....	....	....	....
Total	10.773	....	10,773	2,893	3,056	477	....	....	....	....	....
Butter (88)	7,711	....	7,711	77	6,554	....	....	....	....	....	....
Total animal food	41,959	1,814	39,691	8,204	16,020	524	454	123	137	....	1
VEGETABLE FOOD.											
Cereals:											
Hominy (94)	9,979	5,897	4,082	82	37	776	....	....	....	....	....
Oatmeal (113)	9,639	2,381	5,897	153	71	619	1,361	35	16	143	14
Rice (124)	12,247	7,371	4,876	59	....	590	....	....	....	....	....
Wheat breakfast food (127)	4,876	2,381	2,495	45	10	342	....	....	....	....	....
Wheat breakfast food (128)	4,536	2,041	2,495	62	10	389	....	....	....	....	....
Bread (133)	87,431	3,741	78,473	7,220	1,020	41,669	5,217	480	68	2,770	6
Crackers (134)	3,742	453	3,289	322	299	2,404	....	....	....	....	....
Cake (137)	2,495	....	2,495	157	115	1,420	....	....	....	....	....
Gingerbread and cakes (141)	5,783	....	5,670	329	510	3,600	113	7	10	72	2
Total	140,728	24,265	109,772	8,429	2,072	51,809	6,691	522	94	2,985	5
Sugar (146)	2,268	....	2,268	....	....	2,268	....	....	....	....	....
Vegetables:											
Beans, kidney (153)	9,185	....	8,505	604	51	1,607	680	49	4	129	7
Beans, baked (150)	4,989	907	3,969	385	254	1,000	113	11	7	28	3
Beans, baked (151)	5,670	....	4,763	424	281	1,257	907	81	54	239	16
Cabbage (166)	4,536	....	4,536	86	18	299	....	....	....	....	....
Kale (181)	3,743	....	3,289	46	125	164	454	6	17	23	12
Potatoes, steamed (207)	26,421	7,144	17,803	338	18	2,670	1,474	28	1	221	6
Pickles, cucumber (190)	3,062	794	1,814	9	5	49	454	2	1	12	15

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 385—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Soup, bean (239)	68,040	....	68,040	1,429	136	4,559	....	....	....	....	....
Soup, vegetable (253)	22,680	....	22,680	159	....	1,361	....	....	....	....	....
Sauce, rhubarb (234)	4,309	1,588	2,381	12	14	550	340	2	2	79	8
Tomatoes (268)	4,196	....	3,289	53	46	414	907	15	13	114	22
Total	156,831	10,433	141,069	3,545	948	13,930	5,329	194	99	845	3
Fruits, etc.:											
Jelly, apple (292)	7,258	....	6,124	18	....	4,287	1,134	3	....	794	16
Sauce, apple (300)	4,309	....	4,196	17	21	1,271	113	....	1	34	3
Sauce, peach (307)	10,773	3,402	5,783	110	23	1,839	1,588	30	6	505	15
Sauce, prune (291)	11,566	1,134	10,092	81	....	4,128	340	3	....	139	3
Total	33,906	4,536	26,195	226	44	11,525	3,175	36	7	1,472	9
Total vegetable food	333,733	39,234	279,304	12,200	3,064	79,532	15.195	752	200	5,302	5
MISCELLANEOUS FOOD.											
Macaroni and tomato (334)	4,649	453	3,062	107	15	588	1,134	40	6	218	24
Pie, evaporated-apple (345)	4,536	....	4,536	141	444	1,941	....	....	....	....	....
Pie, evaporated-peach (349)	4,536	....	4,536	154	798	1,746	....	....	....	....	....
Pudding, bread (353)	8,505	1,474	6,124	159	141	1,353	907	24	21	200	11
Stew, beef (316)	14,742	2,381	11,000	1,089	1,012	770	1,361	135	125	95	9
Total	36,968	4,308	29,258	1,650	2,410	6,398	3,402	199	152	513	9
Total food	412,660	45,356	348,253	22,054	21,494	86,454	19,051	1,074	489	5,815	5
Dietary study No. 386.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Beefsteak (26)	2,722	....	2,722	675	749	....	....	....	....	....	....
Boiled (9)	4,309	227	4,082	1,196	1,351	....	....	....	....	....	....

Corned (31)	4,990	1,361	3,629	1,067	806	....	....	....	....	....	....
Roast (14)	4,422	....	3,515	728	766	....	907	188	198	....	21
Total	16,443	1,588	13,948	3,666	3,672	....	907	188	198	....	6
Pork:											
Sausage (62)	2,722	....	2,722	547	1,505	44	....	....	....	....	....
Shoulder (57)	4,763	2,268	2,495	509	676	....	....	....	....	....	....
Total	7,485	2,268	5,217	1,056	2,181	44	....	....	....	....	....
Fish;											
Herring (73)	7,598	1,927	5,217	1,414	1,487	318	454	123	129	28	6
Mackerel (80)	2,722	....	2,722	713	762	....	....	....	....	....	....
Total	10,320	1,927	7,939	2,127	2,249	318	454	123	129	28	4
Butter (88)	7,711	....	7,711	77	6,554	....	....	....	....	....	....
Total animal food	41,959	5,783	34,815	6,926	14,656	362	1,361	311	327	28	3
VEGETABLE FOOD.											
Cereals:											
Hominy (94)	9,298	2,154	6,690	134	60	1,271	454	9	4	86	5
Oatmeal (113)	9,753	....	9,753	254	117	1,024	....	....	....	....	....
Rice (124)	10,546	1,814	7,371	88	....	892	1,361	16	....	165	13
Wheat breakfast food (127)	5,217	2,495	2,722	49	11	373	....	....	....	....	....
Wheat breakfast food (128)	4,423	....	4,196	105	17	655	227	6	1	35	5
Bread (133)	87,204	12,019	62,257	5,728	809	33,058	12,928	1,189	168	6,865	15
Cake (137)	2,495	....	2,041	129	94	1,161	454	29	21	258	18
Crackers (134)	3,288	226	2,949	289	268	2,156	113	11	10	83	3
Ginger cakes and bread (141)	5,897	....	5,897	342	531	3,745	....	....	....	....	....
Total	138,121	18,708	103,876	7,118	1,907	44,335	15,537	1,260	204	7,492	11
Sugar (146)	2,268	....	2,268	....	....	2,268	....	....	....	....	....
Vegetables:											
Beans, kidney (153)	9,526	1,361	7,711	547	46	1,457	454	32	3	86	5
Beans, baked (150)	5,103	....	4,990	484	319	1,257	113	11	7	28	2
Beans, baked (151)	6,123	....	5,783	515	341	1,527	340	30	20	90	6
Cabbage (166)	4,763	....	4,763	90	19	314	....	....	....	....	....
Kale (181)	3,629	....	3,629	51	138	181	....	....	....	....	....
Pickles, cucumber (190)	2,608	453	1,701	9	5	46	454	2	1	12	17
Potatoes, steamed (207)	26,989	8,618	17,464	332	17	2,620	907	17	1	136	3
Sauce, rhubarb (234)	4,309	....	4,309	22	26	995	....	....	....	....	....
Soup, bean (239)	68,040	....	68,040	1,429	136	4,559	....	....	....	....	....
Soup, vegetable (253)	22,680	....	22,680	159	....	1,361	....	....	....	....	....
Tomatoes (268)	3,742	....	3,742	60	52	471	....	....	....	....	....
Total	157,512	10,432	144,812	3,698	1,099	14,788	2,268	92	32	352	1

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 386—Continued.											
VEGETABLE FOOD—continued.											
Fruits, etc.:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Jelly, apple (292)	7,371	1,588	4,876	15		3,413	907	3		635	1
Sauce, apple (300)	4,309		4,082	16	20	1,237	227	1	1	69	52
Sauce, peach (307)	10,206		7,031	134	28	2,236	3,175	60	13	1,010	31
Sauce, prune (291)	10,207		9,753	78		3,989	454	4		186	4
Total	32,093	1,588	25,742	243	48	10,875	4,763	68	14	1,900	15
Total vegetable food	329,994	30,728	276,698	11,059	3,054	72,266	22,568	1,420	250	9,744	7
MISCELLANEOUS FOOD.											
Macaroni and tomato (334)	5,217	681	4,536	159	23	871					
Pie, evaporated-apple (351)	4,536		4,536	141	445	1,941					
Pie, evaporated-peach (349)	4,536		4,536	154	798	1,746					
Pudding, bread (353)	7,938	3,062	4,309	112	99	952	567	15	13	125	7
Stew, beef (316)	15,650		14,289	1,415	1,315	1,000	1,361	135	125	95	9
Total	37,877	3,743	32,206	1,981	2,680	6,510	1,928	150	138	220	5
Total food	409,830	40,254	343,719	19,966	20,390	79,138	25,857	1,881	715	9,992	6
Dietary study No. 387.											
ANIMAL FOOD.											
Beef, veal, and mutton:											
Beefsteak (26)	6,463	1,700	3,969	984	1,091		794	197	218		12
Hamburg steak (27)	1,701		1,361	350	157	39	340	87	39	10	20
Roast (16)	794		794	207	291						
Roast (15)	3,515	453	3,062	701	735						
Veal cutlets (36)	2,041	453	1,361	363	229		227	61	38		14
Veal roast (37)	2,608	794	1,814	497	109						
Total	17,122	3,400	12,361	3,102	2,612	39	1,361	345	295	10	8

Pork:											
Bacon (52)	2,041	....	1,361	297	774	....	680	148	387	....	33
Ham (53)	2,495	454	1,814	385	533	....	227	48	67	....	9
Sausage (61)	1,474	....	1,131	279	682	24	340	84	204	7	23
Shoulder (57)	567	....	567	116	154	....	....	....	....	....	....
Shoulder (56)	2,722	1,588	1,134	194	306	....	....	....	....	....	....
Total	9,299	2,042	6,010	1,271	2,449	24	1,247	280	658	7	13
Fish:											
Herring (73)	454	....	454	123	129	28	....	....	....	....	....
Shad (74)	1,701	....	1,701	153	201	32	....	....	....	....	....
Total	2,155	....	2,155	276	330	60	....	....	....	....	....
Milk (91)	38,102	....	38,102	1,257	1,524	1,905	....	....	....	....	....
Butter (88)	3,175	1,559	1,616	16	1,374	....	....	....	....	....	....
Eggs, fried (86)	1,474	....	1,474	200	290	....	....	....	....	....	....
Total animal food	71,327	7,001	61,718	6,122	8,579	2,028	2,608	625	953	17	4
VEGETABLE FOOD.											
Cereals:											
Mush, corn-meal (98)	794	....	340	4	1	49	454	6	2	65	57
Oatmeal (113)	8,051	....	4,195	109	50	440	3,856	100	46	405	48
Rice (122)	5,443	1,134	3,175	41	3	445	1,134	16	1	159	21
Wheat breakfast food (129)	1,247	....	680	13	2	78	567	11	2	65	45
Bread (133)	30,164	8,732	17,010	1,565	221	9,032	4,422	407	57	2,348	15
Cake, cocoanut frosting (139)	1,588	....	1,588	94	143	1,029	....	....	....	....	....
Crackers (134)	3,288	453	2,722	267	248	1,990	113	11	10	83	3
Corn bread (132)	3,175	....	1,474	87	162	559	1,701	100	187	645	54
Macaroni (143)	2,382	....	794	26	17	125	1,588	52	33	251	67
Toast (136)	567	....	567	65	9	347	....	....	....	....	....
Total	56,699	10,319	32,545	2,274	856	14,094	13,835	703	338	4,021	24
Sugar (146)	7,711	....	7,711	....	....	7,711	....	....	....	....	....
Vegetables:											
Beans, baked (151)	3,629	....	3,402	303	201	898	227	20	13	60	6
Beans, Lima (155)	1,815	....	1,361	76	7	280	454	25	2	94	25
Cabbage (166)	2,268	....	1,814	34	7	120	454	9	2	30	20
Onions, green (183)	1,134	....	1,134	11	1	127	....	....	....	....	....
Onions, fried (185)	1,020	....	907	9	227	100	113	1	28	12	11
Potatoes, fried (222)	7,484	....	3,742	94	311	805	3,742	94	41	805	50
Potatoes, boiled and browned (217)	4,422	....	2,608	65	3	542	1,814	45	2	377	41
Potatoes, baked (203)	9,525	5,216	3,175	79	3	635	1,134	28	1	227	12
Potatoes, mashed and creamed (230)	2,495	....	1,361	34	39	238	1,134	28	33	198	45
Potatoes, boiled (213)	10,432	4,989	3,629	83	....	704	1,814	42	....	352	17
Potato cakes (231)	1,475	....	1,021	20	56	179	454	9	25	79	31
Potatoes, baked (204)	2,268	....	907	23	1	189	1,361	34	1	283	60
Peas (189)	1,361	....	794	31	8	93	567	22	6	66	42
Saratoga chips (233)	680	....	680	46	271	318	....	....	....	....	....

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 387—Continued.											
VEGETABLE FOOD—continued.											
Vegetables—Continued.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per. ct.*
Sauce, rhubarb (234)	1,248	....	794	4	5	183	454	2	3	105	36
Slaw (236)	1,021	....	1,021	16	3	57	....	....	....	....	....
Soup, vegetable (253)	13,834	....	9,412	66	....	565	4,422	31	....	265	32
Soup, tomato (245)	3,175	....	3,175	10	16	152	....	....	....	....	....
Soup, bean (239)	3,743	....	2,722	57	5	182	1,021	21	2	68	27
Lettuce (182)	1,361	....	1,361	16	4	39	....	....	....	....	....
Total	74,390	10,205	45,020	1,077	1,168	6,406	19,165	411	429	3,021	26
Fruits, etc.:											
Sauce, apple (300)	3,969	....	3,289	13	16	997	680	3	3	206	17
Sauce, prune (290)	3,288	1,134	1,474	10	....	506	680	5	....	233	21
Sauce, peach (306)	1,701	....	1,247	20	4	424	454	7	1	154	27
Total	8,958	1,134	6,010	43	20	1,927	1,814	15	4	593	20
Total vegetable food	147,758	21,658	91,286	3,394	2,044	30,138	34,814	1,129	771	7,635	24
MISCELLANEOUS FOOD.											
Chicken, baked and stuffed (320)	3,402	....	3,175	692	346	121	227	49	25	9	7
Griddle cakes (331)	1,474	....	1,361	88	31	506	113	7	3	42	8
Ham omelet (327)	2,041	....	1,701	228	349	....	340	46	70	....	17
Ice cream (340)	4,990	....	4,990	195	200	1,053	....	....	....	....	....
Jelly, lemon (342)	3,403	....	2,949	91	....	519	454	14	....	80	13
Muffins (335)	3,176	....	2,722	269	425	1,059	454	45	71	177	14
Onions, creamed (343)	2,495	....	1,361	16	24	67	1,134	11	20	56	46
Hash (309)	1,020	....	907	106	218	88	113	13	27	11	11
Pie, lemon (347)	3,175	1,587	1,588	57	160	594	....	....	....	....	....
Pie, evaporated-peach (349)	2,722	....	2,722	93	479	1,018	....	....	....	....	....
Pudding, floating island (362)	2,495	....	2,268	107	102	433	227	11	10	43	9
Pudding, rice (364)	2,949	....	2,495	95	82	404	454	17	15	74	15
Soup, clam (325)	2,949	....	2,495	62	62	90	454	11	11	16	15
Stew, beef (316)	3,402	....	1,588	157	146	111	1,814	180	167	127	53
Total	39,693	1,587	32,322	2,256	2,624	6,093	5,784	407	419	635	15
Total food	258,778	30,246	185,326	11,772	13,247	38,259	43,206	2,161	2,143	8,287	17

Dietary study No. 388.

ANIMAL FOOD.											
Beef, veal, and mutton:											
Beefsteak (26)	4,422	1,133	2,949	731	811	....	310	84	94	....	8
Hamburg steak (27)	1,131	....	567	146	65	16	567	146	65	16	50
Roast (15)	2,381	680	1,701	390	408	....	....	....	....	....	....
Roast (16)	567	340	227	59	83	....	....	....	....	....	....
Veal cutlets (36)	1,134	680	454	121	76	....	....	....	....	....	....
Veal roast (37)	1,701	680	794	218	48	....	227	62	14	....	13
Total	11,339	3,513	6,692	1,665	1,481	16	1,134	292	173	16	10
Pork:											
Bacon (52)	1,361	....	907	198	516	....	454	99	258	....	33
Ham (53)	1,587	113	1,361	289	400	....	113	24	33	....	7
Sausage (61)	907	340	454	112	273	10	113	28	68	2	12
Shoulder (57)	680	....	680	139	184	....	....	....	....	....	....
Shoulder (55)	1,814	453	1,361	233	367	....	....	....	....	....	....
Total	6,349	906	4,763	971	1,740	10	680	151	359	2	11
Fish:											
Herring (73)	567	....	567	154	162	35	....	....	....	....	....
Shad (74)	1,134	....	907	82	107	17	227	20	27	4	20
Total	1,701	....	1,474	236	269	52	227	20	27	4	13
Milk (91)	43,516	....	43,546	1,437	1,742	2,177	....	....	....	....	....
Butter (88)	3,175	850	2,325	23	1,976	....	....	....	....	....	....
Eggs, fried (86)	793	....	680	92	134	....	113	15	22	....	14
Total animal food	66,903	5,269	59,480	4,424	7,342	2,255	2,154	478	581	22	3
VEGETABLE FOOD.											
Cereals:											
Mush, corn-meal (98)	794	....	340	4	1	49	454	6	2	65	57
Oatmeal (113)	8,164	....	1,474	38	18	155	6,690	174	80	702	82
Rice (122)	1,815	....	1,361	19	1	191	454	6	....	61	25
Wheat breakfast food (129)	1,247	....	113	2	....	13	1,134	22	3	129	91
Bread (133)	22,000	12,927	7,485	689	97	3,975	1,588	146	21	843	7
Cake, cocoanut frosting (139)	1,020	....	680	40	61	441	340	20	31	220	33
Crackers (134)	3,062	567	2,268	222	206	1,658	227	22	21	166	7
Corn bread (132)	2,151	453	794	47	87	301	907	54	100	344	42
Macaroni (143)	1,134	....	340	11	7	54	791	26	17	125	70
Toast (136)	454	....	454	52	7	278	....	....	....	....	....
Total	41,844	13,947	15,309	1,124	485	7,115	12,588	476	275	2,658	30
Sugar (146)	4,536	....	4,536	....	....	4,536	....	....	....	....	....

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 388—Continued.											
VEGETABLE FOOD—continued.											
Vegetables:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Beans, baked (151)	2,721	....	1,474	131	87	389	1,247	111	74	329	46
Beans, Lima (155)	1,134	....	680	38	3	140	454	25	2	94	40
Cabbage (166)	1,134	226	454	9	2	30	454	9	2	30	40
Lettuce (182)	1,361	....	907	11	3	26	454	5	1	13	33
Onions, green (183)	1,021	....	1,021	10	1	114	....	....	....	....	....
Onions, fried (185)	681	....	454	5	114	50	227	2	57	25	33
Potatoes, fried (222)	4,876	....	1,701	43	141	366	3,175	79	264	683	65
Potatoes, boiled and browned (217)	2,495	567	1,021	26	1	212	907	23	1	189	36
Potatoes, baked (203)	6,577	4,422	2,155	54	2	431	....	....	....	....	....
Potatoes, mashed and creamed (230)	1,134	....	794	20	23	139	340	9	10	60	30
Potatoes, boiled (213)	6,010	3,175	1,814	42	....	352	1,021	23	....	198	17
Potato cakes (231)	794	....	227	5	12	40	567	11	31	99	71
Potatoes, baked (204)	2,268	907	1,361	34	1	283	....	....	....	....	....
Peas (189)	1,474	....	567	22	6	66	907	35	9	106	62
Sauce, rhubarb (234)	1,247	....	680	3	4	157	567	3	3	131	45
Slaw (236)	1,020	....	340	5	1	19	680	11	2	38	67
Saratoga chips (233)	567	....	340	23	135	159	227	15	90	106	40
Soup, bean (239)	3,402	....	3,402	71	7	228	....	....	....	....	....
Soup, tomato (245)	3,402	....	3,402	10	17	163	....	....	....	....	....
Soup, vegetable (253)	12,360	....	10,546	74	....	633	1,814	13	....	109	15
Total	55,678	9,297	33,340	636	560	3,997	13,041	374	546	2,210	23
Fruits, etc.:											
Sauce, apple (300)	2,608	....	1,134	5	6	344	1,474	6	7	447	57
Sauce, peach (306)	1,361	....	454	3	1	154	907	15	3	308	67
Sauce, prune (290)	2,949	1,134	1,361	10	....	467	454	3	....	156	15
Total	6,918	1,134	2,949	18	7	965	2,835	24	10	911	41
Total vegetable food	108,976	24,378	56,134	1,778	1,052	16,613	28,464	874	831	5,779	26
MISCELLANEOUS FOOD.											
Chicken, baked and stuffed (320)	2,608	....	2,268	494	247	86	340	74	37	13	13
Griddle cakes (331)	1,247	....	907	59	21	337	340	22	8	126	27

Ham omelet (327)	1,020	......	680	91	139	......	340	46	70	......	33
Ice cream (340)	3,629	......	3,629	142	145	766	......	......	......	......	......
Hash (309)	1,701	......	454	53	109	44	1,247	146	299	121	73
Jelly, lemon (342)	2,495	......	2,268	70	......	399	227	7	......	40	9
Onions, creamed (343)	1,588	......	1,134	14	20	56	454	5	8	22	29
Muffins (335)	2,495	1,020	1,021	101	159	397	454	45	71	177	18
Pie, lemon (347)	3,175	1,587	1,588	57	160	594	......	......	......	......	......
Pie, evaporated-peach (349)	2,722	1,474	794	27	140	306	454	15	80	175	17
Pudding, floating island (362)	2,495	......	2,268	107	102	433	227	11	10	43	9
Pudding, rice (364)	2,949	1,588	907	34	30	147	454	17	15	74	15
Stew, beef (316)	3,175	......	907	90	83	63	2,268	225	209	159	71
Soup, clam (325)	2,835	......	2,835	71	71	102	......	......	......	......	......
Total	34,134	5,669	21,660	1,410	1,426	3,730	6,805	613	807	950	20
Total food	210,013	35,316	137,274	7,612	9,820	22,598	37,423	1,965	2,219	6,751	18
Dietary study No. 389.											
ANIMAL FOOD.											
Beef and veal:											
Roast (15)	4,309	2,608	1,361	312	327	......	340	78	82	......	8
Roast (16)	680	......	567	148	208	......	113	29	41	......	17
Steak (26)	5,783	907	4,649	1,153	1,278	......	227	56	62	......	4
Steak, Hamburg (27)	1,588	......	1,134	291	130	33	454	117	52	13	29
Veal cutlets (36)	1,814	907	907	242	152	......	......	......	......	......	......
Veal roast (37)	2,381	1,247	907	249	54	......	227	62	14	......	10
Total	16,555	5,669	9,525	2,395	2,149	33	1,361	342	251	13	8
Pork:											
Bacon, fried (52)	1,587	......	680	148	387	......	907	198	516	......	57
Ham, fried (53)	2,268	284	1,984	421	583	......	......	......	......	......	......
Shoulder (57)	680	226	227	46	62	......	227	46	62	......	33
Shoulder, baked (55)	2,041	......	2,041	349	551	......	......	......	......	......	......
Sausage, fried (61)	1,021	454	454	112	273	10	113	28	68	2	11
Total	7,597	964	5,386	1,076	1,856	10	1,247	272	646	2	16
Fish:											
Herring, fresh, fried (73)	907	......	907	246	258	55	......	......	......	......	......
Shad, broiled (74)	1,134	......	907	82	107	17	227	20	27	......	20
Total	2,041	......	1,814	328	365	72	227	20	27	......	11
Milk (91)	74,390	......	74,390	2,455	2,976	3,720	......	......	......	......	......
Butter (88)	3,175	2,495	680	7	578	......	......	......	......	......	......
Eggs, fried (86)	1,134	......	1,134	154	223	......	......	......	......	......	......
Total animal food	104,892	9,128	92,929	6,415	8,147	3,835	2,835	634	924	15	3

TABLE 35.—*Amounts and composition of food provided, eaten, and wasted in the dietary studies*—Continued.

Kind of food.	Food provided.	Food returned.	Food served.								Proportion of provided food rejected.
			Eaten.				Wasted.				
			Amount.	Protein.	Fat.	Carbohydrates.	Amount.	Protein.	Fat.	Carbohydrates.	
Dietary study No. 389—Continued.											
VEGETABLE FOOD.											
Cereals:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*
Bread, biscuit, etc. (133)	22,000	4,706	13,892	1,278	181	7,377	3,402	313	44	1,806	15
Cake, cocoanut frosting (139)	1,021		1,021	60	92	662					
Corn bread (132)	2,155	794	454	27	50	172	907	54	100	344	42
Crackers (134)	3,515	226	3,289	322	299	2,404					
Macaroni, boiled (143)	1,587		1,474	49	31	233	113	4	2	18	7
Mush, corn-meal (98)	681		227	3	1	33	454	6	2	65	67
Oatmeal (113)	7,939		2,949	77	35	310	4,990	130	60	524	63
Rice, boiled (122)	1,588		454	6		64	1,134	16	1	159	71
Toast (136)	454	227	227	26	4	139					
Wheat breakfast food (129)	1,247		340	6	1	39	907	17	3	103	73
Total	42,187	5,953	24,327	1,854	694	11,433	11,907	540	212	3,019	28
Sugar (146)	6,804		6,804			6,804					
Vegetables:											
Beans, baked (151)	3,062		1,588	141	94	419	1,474	131	87	389	48
Beans, Lima, boiled (155)	1,361		794	44	4	164	567	32	3	117	42
Peas, stewed (189)	1,928						1,928	75	19	226	100
Cabbage, boiled (166)	1,587		1,247	24	5	82	340	6	1	22	21
Lettuce (182)	1,361		794	10	2	23	567	7	2	16	42
Onions, green (183)	907	453	454	5		51					
Onions, fried (185)	1,134		794	8	199	87	340	3	85	37	30
Potatoes, baked (204)	2,495	1,361	907	23	1	189	227	6		47	9
Potatoes, boiled (213)	7,031	1,361	3,515	81		681	2,155	50		418	31
Potatoes, baked (203)	6,463	3,968	2,155	54	2	431	340	9		68	5
Potatoes, boiled and browned (217)	3,175		2,268	57	2	472	907	23	1	189	29
Potatoes, fried (222)	5,443		2,041	51	169	439	3,402	85	282	731	63
Potatoes, mashed and creamed (230)	1,361		567	14	16	99	794	20	23	139	58
Saratoga chips (233)	567		454	31	181	212	113	8	45	53	20
Potato cakes (231)	1,021		567	11	31	99	454	9	25	79	44
Rhubarb sauce (234)	1,248		1,021	5	6	236	227	1	1	52	18
Slaw (236)	1,021		454	7	1	25	567	9	2	32	56
Soup, bean (239)	3,289		3,289	69	7	220					

Soup, tomato (245)	3,402	....	3,402	10	17	163	....	....	....	....	....
Soup, vegetable (253)	14,515	....	14,515	102	....	871	....	....	....	....	....
Total	62,371	7,143	40,826	747	737	4,963	14,402	474	576	2,615	23
Fruits, etc.:											
Prunes, stewed (290)	3,061	....	1,247	9	....	428	1,814	13	....	622	59
Sauce, apple (300)	3,289	....	1,361	5	7	412	1,928	8	10	584	59
Sauce, peach (306)	1,588	....	227	4	1	77	1,361	22	4	463	86
Total	7,938	....	2,835	18	8	917	5,103	43	14	1,669	64
Total vegetable food	119,300	13,096	74,792	2,619	1,439	24,117	31,412	1,057	802	7,303	26
MISCELLANEOUS FOOD.											
Hash, baked (309)	1,701	....	1,701	199	408	165	....	....	....	....	....
Chicken, baked and stuffed (320)	2,835	....	2,835	618	309	108	....	....	....	....	....
Omelet, ham (327)	1,248	....	1,021	137	209	....	227	30	47	....	18
Stew, beef (316)	3,855	....	1,247	123	115	87	2,608	258	240	183	68
Soup, clam (325)	2,949	....	2,949	74	74	106	....	....	....	....	....
Griddle cakes (331)	1,361	....	1,361	88	31	506	....	....	....	....	....
Ice cream (340)	5,443	....	5,443	212	218	1,148	....	....	....	....	....
Jelly lemon (342)	3,402	....	2,041	63	....	359	1,361	42	....	210	40
Muffins (335)	2,722	454	1,814	180	283	706	454	45	71	177	17
Pudding, floating island (362)	2,721	....	1,814	85	82	346	907	43	41	173	33
Pudding, rice (364)	2,949	....	2,722	103	90	441	227	9	7	37	8
Pie, lemon (347)	3,175	907	1,814	65	183	678	454	16	46	170	14
Onions, creamed (343)	1,701	....	794	10	14	39	907	11	16	44	53
Pie, evaporated peach (349)	2,721	567	1,814	62	319	698	340	12	60	131	12
Total	38,783	1,928	29,370	2,019	2,335	5,387	7,485	466	528	1,155	19
Total food	262,975	24,152	197,091	11,053	11,921	33,339	41,732	2,157	2,254	8,473	16

FOOD ISSUED FROM STOREROOM FOR ONE YEAR.

The following table shows the kinds and amounts of food issued from the storeroom of the hospital to all the kitchens during the fiscal year July 1, 1901, to June 30, 1902, as shown by the ledger accounts of the storeroom. The quantities of different nutrients in each kind of food are also included in the table and the values for percentage composition by which they were computed, the latter being assumed from averages of analyses of similar materials.[a]

Table 36.—*Total weight, composition, and amount of nutrients in food issued from the storeroom for the year July 1, 1901, to June 30, 1902.*

Kind of food material.	Percentage composition.			Weight used.			
	Protein.	Fat.	Carbohydrates.	Total food material.	Nutrients.		
					Protein.	Fat.	Carbohydrates.
ANIMAL FOOD.							
Beef:	*Per ct.*	*Per ct.*	*Per ct.*	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*
Corned	14.3	23.8	....	34,977.5	5,001.7	8,324.7	....
Dried, canned	39.2	5.4	....	1,544.8	605.5	83.4	....
Gelatin	91.4	.1	....	245.9	224.7	.2	....
Liver	20.2	3.1	2.5	5,708.0	1,153.0	176.9	142.7
Liver pudding	20.2	3.1	2.5	39.5	8.0	1.2	1.0
Meat pudding	20.2	3.1	2.5	59.1	12.0	1.8	1.5
Oxtails, as canned	18.5	4.5	....	68.1	12.6	3.1	....
Soup, as bouillon	2.2	.1	.1	51.7	1.1	....	....
Tongue	11.9	19.2	....	563.7	67.1	108.2	....
Tripe	11.7	1.2	.2	181.4	21.3	2.2	.4
Unclassified	14.8	18.1	....	144,544.5	21,392.6	26,162.6	....
Veal, fresh, side	15.6	6.3	....	9,334.1	1,456.1	588.0	....
Lamb and mutton:							
Lamb, fresh, side	14.1	18.7	....	10,244.7	1,444.5	1,915.8	....
Mutton, fresh, side	13.0	24.0	....	7,575.9	984.9	1,818.2	....
Total	....	....	....	215,138.9	32,385.1	39,186.3	145.6
Pork:							
Bacon	9.1	62.2	....	10,170.1	925.5	6,325.7	....
Fresh pork, side	8.0	49.0	....	17,800.0	1,424.0	8,722.0	....
Ham, potted	19.0	34.1	....	21.0	4.0	7.1	....
Ham, smoked	14.2	33.4	....	15,243.5	2,164.6	5,091.3	....
Loins	13.4	24.2	....	2,038.6	273.1	493.3	....
Pig's feet, fresh	4.1	6.9	....	1,360.9	55.8	93.9	....
Lard	....	100.0	....	22,247.4	....	22,247.4	....
Salt pork	1.9	86.2	....	917.7	17.4	791.0	....
Sausage, salted and smoked	15.6	31.9	.5	17,746.1	2,768.4	5,661.0	88.7
Shoulder, smoked	13.0	26.6	....	35,611.1	4,629.5	9,472.6	....
Total	....	....	....	123,156.4	12,262.3	58,905.4	88.7
Poultry:							
Chicken	13.7	12.3	....	10,282.7	1,408.7	1,264.7	....
Duck	13.4	29.8	....	477.1	63.9	142.2	....
Turkey	16.1	18.4	....	3,568.1	574.5	656.5	....
Total	....	....	....	14,327.9	2,047.1	2,063.4	....
Fish, etc.:							
Clams, round, solids	10.6	1.1	5.2	695.5	73.7	7.6	36.2
Cod, salt	16.0	.4	....	3,147.3	503.5	12.6	....
Cod, shredded	28.6	.3	....	2.0	.6	....	....
Herring	11.2	3.9	....	3,083.5	345.4	120.2	....
Herring, smoked	20.5	8.8	....	190.9	39.1	16.8	....
Lobster	5.9	.7	.2	24.5	1.4	.2	....
Mackerel, salt	16.3	17.4	....	13,112.1	2,137.3	2,281.5	....
Oysters, in shell	1.2	.2	.7	25.6	.3	....	.2
Oysters, solids	6.0	1.3	3.3	5,137.2	308.2	66.8	169.5
Salmon, canned	19.5	7.5	....	554.1	108.1	41.5	....
Salmon, smoked	19.3	14.0	....	19.1	3.7	2.7	....
Sardines	23.7	12.1	....	36.1	8.6	4.4	....
Shrimps, canned	25.4	1.0	.2	6.8	1.7	.1	....
Shad	9.4	4.8	....	1,418.1	133.3	68.1	....
Unclassified fish	8.1	.5	....	29,047.0	2,352.8	145.3	....
Total	....	....	....	56,499.8	6,017.7	2,767.8	205.9

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 28, revised.

TABLE 36.—*Total weight, composition, and amount of nutrients in food, etc*—Continued.

Kind of food material.	Percentage composition.			Weight used.			
					Nutrients.		
	Protein.	Fat.	Carbohydrates.	Total food material.	Protein.	Fat.	Carbohydrates.
ANIMAL FOOD—continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*
Eggs	13.1	9.3		29,389.4	3,850.0	2,733.3	
Butter	1.0	85.0		45,450.5	454.6	38,633.0	
Cheese:							
Cream	25.9	33.7	2.4	5,681.8	1,471.7	1,914.8	136.5
Edam	25.9	33.7	2.4	36.5	9.4	12.3	.8
Total				5,718.3	1,481.0	1,927.1	137.3
Milk and cream:							
Condensed milk	8.8	8.3	54.1	323.2	28.4	26.8	174.8
Whole milk	3.3	4.0	5.0	401,194.5	13,239.5	16,047.7	20,059.7
Evaporated cream	9.6	9.3	11.2	2,908.3	279.2	270.5	325.7
Total				404,426.0	13,547.1	16,345.0	20,560.2
Total animal food				894,107.2	72,045.0	162,561.3	21,137.7
VEGETABLE FOOD.							
Cereals:							
Barley	8.5	1.1	77.8	898.6	76.4	9.9	699.1
Buckwheat flour	6.4	1.2	77.9	818.2	52.4	9.8	637.4
Corn meal	7.1	1.3	78.4	6,753.4	479.5	87.8	5,294.8
Chocolate wafers	12.9	48.7	30.3	6.8	.8	3.3	2.0
Crackers, cream	9.7	12.1	69.7	174.1	16.9	21.0	121.3
Crackers, reception	10.6	12.7	68.5	75.9	8.0	9.6	52.0
Crackers, soda	9.8	9.1	73.1	13,575.9	1,330.4	1,235.5	9,924.0
Wheat breakfast food	11.0	1.4	76.3	2.3	.3		1.7
Ginger cakes	6.5	8.6	76.0	1,753.6	114.0	150.8	1,332.8
Ginger snaps	6.5	8.6	76.0	545.4	35.5	46.9	414.5
Cereal breakfast food	11.7	1.2	79.9	17.7	2.1	.2	14.1
Hominy	8.3	.6	79.0	4,764.6	395.5	28.6	3,764.0
Macaroni	13.4	.9	74.1	2,322.3	311.2	20.9	1,720.8
Oats, rolled	16.7	7.3	66.2	6,453.7	1,077.8	471.3	4,272.3
Pop corn	10.7	5.0	78.7	11.4	1.2	.6	8.9
Rice	8.0	.3	79.0	7,704.5	616.3	23.1	6,086.7
Rice, flaked	7.9	.4	81.9	75.5	6.0	.3	61.8
Shredded wheat	10.5	1.4	77.9	48.7	5.1	.7	37.8
Unclassified breakfast foods	12.1	1.8	75.2	4,015.0	485.8	71.7	3,019.3
Vanilla cakes	6.6	14.0	71.6	415.0	27.4	58.1	297.1
Vermicelli	10.9	2.0	72.0	21.6	2.4	.5	15.5
Wheat flour, Graham	13.3	2.2	71.4	2,605.9	346.6	57.3	1,860.6
Wheat breakfast food	13.6	1.9	71.8	4,154.6	565.0	79.1	2,983.0
Zwieback	9.8	9.9	73.5	8.2	.8	.8	6.0
Wheat flour	11.4	1.0	75.1	282,863.6	32,246.5	2,828.7	212,430.8
Total				340,086.5	38,203.9	5,216.5	255,058.3
Sugars, starches, etc.:							
Candy			96.0	519.1			498.3
Chocolate	12.9	48.7	30.3	184.8	24.1	90.0	56.0
Cocoa	21.6	28.9	37.7	239.5	51.9	68.9	89.9
Honey	.4		81.2	226.8	.1		184.3
Molasses			70.0	10,461.0			7,322.9
Olive oil		100.0		123.9		123.9	
Sirup			70.0	10,404.7			7,283.3
Sirup, maple			71.4	296.6			211.7
Corn starch			90.0	795.5			715.9
Sugar, brown			95.0	212.3			201.6
Sugar, cut-loaf			100.0	872.9			872.9
Sugar, granulated			100.0	115,565.7			115,565.7
Sugar, powdered			100.0	785.9			785.9
Tapioca	.4	.1	88.0	352.5	1.5	.4	310.2
Total				141,041.2	77.6	283.3	134,098.8
Vegetables:							
Asparagus	1.8	.2	3.3	315.5	5.7	.6	10.4
Beans, Lima	3.2	.3	9.9	1,660.2	53.1	5.0	164.4
Beans, string	2.1	.3	6.9	1,548.0	32.5	4.6	106.8
Beets	1.3	.1	7.7	5,638.0	73.3	5.6	434.1
Cabbage	1.4	.2	4.8	68,802.3	963.2	137.6	3,302.5

Table 36.—*Total weight, composition, and amount of nutrients in food, etc.*—Continued.

Kind of food material.	Percentage composition.			Weight used.			
					Nutrients.		
	Protein.	Fat.	Carbohydrates.	Total food material.	Protein.	Fat.	Carbohydrates.
VEGETABLE FOOD—cont'd.							
Vegetables—Continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*
Carrots	0.9	0.2	7.4	1,203.9	10.8	2.4	89.1
Cauliflower	1.8	.5	4.7	33.6	.6	.2	1.6
Celery	.9	.1	2.6	2,611.8	23.5	2.6	67.6
Corn, green	1.2	.4	7.7	14,752.5	177.1	59.0	1,136.0
Cucumbers	.7	.2	2.6	2,150.1	15.1	4.3	55.9
Eggplant	1.2	.3	5.1	2,686.5	32.3	8.0	137.0
Kale	1.4	.2	4.8	12,364.8	173.1	24.7	593.5
Lettuce	1.0	.2	2.5	980.9	9.8	2.0	24.5
Onions, dried	1.4	.3	8.9	16,999.5	238.0	50.9	1,510.0
Onions, green	.5	.1	5.5	3,533.3	17.7	3.5	194.3
Oyster plant	1.3	.4	10.8	886.9	11.5	3.5	95.8
Parsnips	1.3	.4	10.8	6,370.9	82.8	25.5	688.0
Peas, green	3.6	.2	9.8	1,672.7	60.2	3.3	163.9
Potatoes, Irish	1.8	.1	14.7	211,329.7	3,804.0	211.4	31,065.5
Peppers, green	6.2	3.4	26.0	345.5	21.4	11.7	89.8
Pumpkins	.5	.1	2.6	15.9	.1	....	.4
Radishes	.9	.1	4.0	6,105.6	55.0	6.1	244.2
Rhubarb	.4	.4	2.2	2,707.7	10.8	10.8	59.6
Sauerkraut	1.7	.5	3.8	3,454.5	58.7	17.3	131.3
Spinach	2.1	.3	3.2	439.8	9.2	1.3	14.1
Squash	.7	.2	4.5	31,904.1	223.3	63.8	1,435.7
Sweet potatoes	1.4	.6	21.9	28,737.4	402.3	172.4	6,293.5
Tomatoes	.9	.4	3.9	15,047.7	135.4	60.2	586.9
Turnips	.9	.1	5.7	30,380.0	273.4	30.4	1,731.6
Beans, Lima, dried	18.1	1.5	65.9	2,114.5	382.7	31.7	1,393.5
Beans, kidney, dried	18.1	1.5	65.9	1,393.2	252.2	20.9	918.1
Beans, white-pea, dried	22.5	1.8	59.6	18,400.0	4,140.0	331.2	10,966.4
Corn, canned	2.8	1.2	19.0	6,812.2	190.7	81.7	1,294.3
Mushrooms, canned	3.5	.4	6.8	15.9	.5	.1	1.1
Peas, canned	3.6	.2	9.8	4,848.3	174.5	9.7	475.1
Peas, split	24.6	1.0	62.0	4,828.2	1,187.7	48.3	2,993.5
Pumpkin, canned	.8	.2	6.7	38.2	.3	.1	2.6
Rhubarb, canned	.6	.7	3.6	7,889.5	47.3	55.2	284.0
Squash, canned	.9	.5	10.5	1,489.1	13.4	7.5	156.4
Tomatoes, canned	1.2	.2	4.0	35,781.1	429.4	71.5	1,431.2
Tomato soup, canned	1.8	1.1	5.6	635.5	11.5	7.0	35.6
Total	....	....	....	558,925.0	13,804.1	1,593.6	70,383.1
Fruits, berries, and nuts:							
Apricots	1.0	....	12.6	38.2	.4	....	4.8
Apples	.3	.3	10.8	7,823.9	23.5	23.5	845.0
Bananas	.8	.4	14.3	1,307.5	10.4	5.2	187.0
Blackberries	1.3	1.0	10.9	10,835.5	140.9	108.4	1,181.1
Cantaloupes	.3	....	4.6	19,028.9	57.1	....	875.3
Cherries	.9	.8	15.9	10,029.1	90.3	80.2	1,594.6
Citron, dried	.5	1.5	78.1	208.5	1.0	3.1	162.9
Cranberries	.4	.6	9.9	274.1	1.1	1.6	27.1
Currants	1.5	....	12.8	190.9	2.9	....	24.5
Crab apples	.3	.3	10.8	57.3	.2	.2	6.2
Damsons	.9	....	19.1	63.6	.6	....	12.1
Figs, fresh	1.5	....	18.8	359.1	5.4	....	67.5
Grapes	1.0	1.2	14.4	14,452.7	144.5	173.5	2,081.2
Grapes, Malaga	1.0	1.2	14.4	202.3	2.0	2.4	29.1
Grapefruit	.6	.1	8.5	42.9	.3	....	3.6
Huckleberries	.6	.6	16.6	374.7	2.2	2.2	62.2
Jelly, apple	.3	....	70.0	4,936.4	14.8	....	3,455.5
Lemons	.7	.5	5.9	3,484.8	24.4	17.4	205.6
Olives	.8	20.2	8.5	182.5	1.4	36.9	15.5
Oranges	.6	.1	8.5	3,105.5	18.6	3.1	264.0
Peaches, fresh	.5	.1	7.7	1,363.6	6.8	1.4	105.0
Pears	.5	.4	12.7	4,636.4	23.2	18.5	588.8
Pineapple	.4	.3	9.7	1,549.5	6.2	4.6	150.3
Plums	.9	....	19.1	50.9	.4	....	9.7
Raspberries	1.7	1.0	12.6	245.5	4.2	2.5	30.9
Strawberries	.9	.6	7.0	5,685.0	51.2	34.1	398.0
Watermelons	.2	.1	2.7	22,180.9	44.4	22.2	598.8
Whortleberries	.7	3.0	13.5	66.6	.5	2.0	9.0
Fruits, dried:							
Apples, evaporated	1.6	2.2	66.1	6,096.8	97.4	134.1	4,030.0
Currants, dried	2.4	1.7	74.2	1,336.8	32.1	22.7	991.9
Dates	1.9	2.5	70.6	4.5	.1	.1	3.2
Figs	4.3	.3	74.2	23.9	1.0	.1	17.7

TABLE 36.—*Total weight, composition, and amount of nutrients in food, etc.*—Continued.

Kind of food material.	Percentage composition.			Weight used.			
					Nutrients.		
	Protein.	Fat.	Carbohydrates.	Total food material.	Protein.	Fat.	Carbohydrates.
VEGETABLE FOOD—cont'd.							
Fruits, dried—Continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Kilograms.*	*Kilograms.*	*Kilograms.*	*Kilograms.*
Peaches, evaporated	4.7	1.0	62.5	10,194.1	479.1	102.0	6,371.3
Prunes, dried	1.8	....	62.2	9,113.2	164.0	....	5,668.4
Raisins	2.3	3.0	68.5	2,280.9	52.5	68.4	1,562.4
Nuts:							
Almonds	11.5	30.2	9.5	24.1	2.8	7.3	2.3
Cocoanuts	2.9	25.9	14.3	40.5	1.2	10.5	5.8
Cocoanut, shredded	6.3	57.4	31.5	61.7	3.9	35.4	19.5
Nuts, mixed	7.9	31.5	6.7	504.5	39.9	159.0	33.8
Walnuts, black	7.2	14.6	3.0	20.9	1.5	3.0	.6
Walnuts, English	6.9	26.6	6.8	2.7	.2	.7	.2
Total	....	....	....	142,481.4	1,554.5	1,086.3	31,702.4
Beverages, condiments, etc.:							
Catsup	1.5	.2	12.3	56.6	.9	.1	7.0
Horse-radish	1.4	.2	10.5	15.2	.2	....	1.6
Mustard, German	4.8	5.6	3.7	35.0	1.6	2.0	1.3
Pickles, chowchow	1.1	.4	4.0	52.7	.6	.2	2.1
Pickles, cucumber	.5	.3	2.7	2,897.8	14.5	8.7	78.2
Pickles, mixed	1.1	.4	4.0	272.7	3.0	1.1	10.9
Yeast	11.7	.4	21.0	717.4	84.0	2.9	150.6
Total	....	....	....	4,047.4	104.8	15.0	251.7
Total vegetable food	....	....	....	1,186,581.5	53,744.9	8,194.7	491,494.3
Total food	....	....	....	2,080,688.7	125,789.9	170,756.0	512,632.0

PERCENTAGE COMPOSITION OF FOODS USED.

Table 37 below shows the percentage composition assumed for each article of food used in the studies herein reported. In the case of food materials eaten in the uncooked state—for instance, bananas, celery, etc.—the values used are averages of analyses of similar materials taken from a previous publication of this Office.[a] In the case of most of the cooked foods the percentage composition was computed from the weight of the cooked food and the weight and composition of the raw materials, as explained on page 15 preceding. In a few cases, through lack of time or because such a course might have interfered with the work of the kitchen employees, it was not possible to take weighings of the ingredients used in preparing the foods, and it was necessary to make use of computed or determined analyses of similar foods made for other purposes.

The reference numbers in the column at the left of the table correspond with those given in parentheses in connection with the materials in Table 35, and serve to indicate the values used in calculating the quantities of nutrients in each. In some cases the values used for such calculation were individual computations of composition, and in others they were averages of several such computations, those values being selected which were believed to correspond most closely to the food material as eaten.

The various food materials have been grouped as usual under the different kinds of animal and vegetable food. Those materials that contained different kinds of food materials and could therefore not be easily classified are grouped as miscellaneous foods. In the case of a few of the articles a brief explanation seems necessary.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 28.

Steaks.—The average of all cuts of steak was used in this set of studies for the reason that at this institution the cuts of steak were not as sharply defined as in ordinary butchers' shops, and hence, while classed perhaps as rib, a lot of steaks might also contain some sirloin and round.

Baked fresh shad was assumed to have the same composition as baked fresh haddock, as the recipe by which the food was prepared was not obtained.

Ham omelet.—This article as served in these studies contained very little ham, but was mostly eggs. As no recipe was obtainable, the omelet was assumed to have the same percentage composition as scrambled eggs.

Clam soup.—No recipe was obtained. It was believed, however, that this article would not be much different in nutritive value from oyster soup, so the percentage composition of this was therefore used for the clam soup.

Wheat breakfast food.—Two different kinds of such breakfast foods were used during these studies.

Bread, biscuits, and rolls.—The percentage composition used for this class of articles is the average for all kinds of bread as found by actual analysis.

Bread dressing for meat.—This was mostly bread. No weighing of the raw ingredients nor of the cooked material were made, but as the quantities used were relatively extremely small it is believed that no appreciable error was introduced by assuming it to be of the same percentage composition as bread.

Baked beans.—A number of weighings of raw and cooked materials were obtained for this food, as the percentage composition is apt to vary widely.

Stewed corn.—Canned corn was prepared in several different ways by the addition of various ingredients.

Fried onions.—In computing the composition of this dish the amount of fat used was assumed.

Fritters.—The very small quantity of this article of food made it seem unnecessary to obtain any weighings of the raw materials used, and fritters were assumed to have the same percentage composition as bread.

Celery salad.—This salad was composed of celery, with a mayonnaise dressing of unknown composition. As the amount of this dressing was extremely small, the celery only was considered, and the percentage composition of the edible portion of celery was assumed.

Table 37.—*Percentage composition of foods used in the dietary studies.*

Reference No.	Kind of food.	Protein.	Fat.	Carbohydrates.
	ANIMAL FOOD.			
	Beef:	*Per cent.*	*Per cent.*	*Per cent.*
1	Boiled, as purchased	15.1	27.5	....
2	Do	18.6	22.8	....
3	Average, Nos. 1 and 2	16.9	25.2	....
4	Boiled, edible portion	30.8	37.7	....
5	Do	30.5	30.6	....
6	Do	31.8	28.3	....
7	Do	24.1	35.8	....
8	Do	26.9	19.0	....
9	Average, Nos. 4-7	29.3	33.1	....
10	Liver, fried with flour and butter	28.6	22.9	28.6
11	Liver, plain	26.0	15.5	2.0
12	Roast, as purchased	23.3	22.5	....
13	Do	22.5	25.5	....
14	Roast, with gravy, as purchased	20.7	21.8	....
15	Average, Nos. 12 and 13	22.9	24.0	....
16	Roast, edible portion	26.1	36.6	....
17	Roast, with gravy, edible portion	23.8	25.0	....
18	Steak, rib, fried, edible portion	23.4	37.4	....
19	Do	22.6	34.4	....
20	Steak, rib and loin, fried	21.3	26.4	....
21	Steak, sirloin, fried	26.2	27.7	....
22	Steak, round, fried	26.3	17.5	....
23	Steak, round and sirloin, fried	23.9	28.7	....
24	Steak, round, fried	30.2	20.2	....

TABLE 37.—*Percentage composition of foods used in the dietary studies*—Continued.

Reference No.	Kind of food.	Protein.	Fat.	Carbohydrates.
	ANIMAL FOOD—continued.			
	Beef—Continued.	*Per cent.*	*Per cent.*	*Per cent.*
25	Average, Nos. 22 and 23	25.1	23.1	....
26	Average, Nos. 18–24	24.8	27.5	....
27	Steak, Hamburg	25.7	11.5	2.9
28	Corned, as purchased	22.9	17.3	....
29	Corned, edible portion	31.3	52.4	....
30	Do	29.9	50.3	....
31	Do	29.4	22.2	....
32	Dried, salted, and smoked, edible portion	30.0	6.5	....
33	Dried, salted, and smoked, stewed	9.5	4.5	5.9
34	Do	22.2	20.0	....
35	Sausage, Bologna	18.7	17.6	.3
	Veal:			
36	Cutlets, edible portion	26.7	16.8	....
37	Roast	27.4	6.0	....
38	Lamb, roast, as purchased	23.1	19.7	....
	Mutton:			
39	Chops	18.4	26.7	....
40	Roast, edible portion	25.0	22.6	....
	Pork:			
41	Boiled	15.7	36.3	....
42	Chops, fried with flour, as purchased	24.3	28.2	12.2
43	Feet, as purchased	5.5	9.1	....
44	Head-cheese	19.5	33.8	....
45	Loin, baked, edible portion	21.9	26.5	....
46	Jowl, boiled, edible portion	18.2	50.5	....
47	Roast, with gravy	27.6	21.6	....
48	Bacon, fried	22.8	40.0	....
49	Do	22.7	69.3	....
50	Do	19.9	61.3	....
51	Average, Nos. 48, 49	22.8	54.7	....
52	Average, Nos. 48–50	21.8	56.9	....
53	Ham, fried	21.2	29.4	....
54	Do	22.2	33.2	....
55	Shoulder, smoked, boiled, as purchased	17.1	27.0	....
56	Shoulder, smoked, boiled, edible portion	22.6	40.5	....
57	Do	20.4	27.1	....
58	Sausage, fried	22.6	48.7	1.9
59	Do	16.4	49.1	1.2
60	Do	21.2	68.2	1.8
61	Do	24.6	60.1	2.1
62	Average, Nos. 58–60	20.1	55.3	1.6
63	Sausage, Frankfort	19.6	18.6	1.1
64	Gravy, pork	.9	35.5	5.3
65	Do	1.1	28.6	4.6
	Poultry, chicken:			
66	Fricasseed, as purchased	10.7	9.3	2.9
67	Stewed, edible portion	12.1	11.4	....
	Fish, etc.:			
68	Codfish, baked	12.9	.2	....
69	Codfish, scalloped	19.8	1.8	8.1
70	Codfish, stuffed	13.8	27.1	4.0
71	Halibut, boiled	22.7	6.3	....
72	Haddock, baked	9.0	11.8	1.9
73	Herring, fried	27.1	28.5	6.1
74	Shad, baked (as haddock)	9.0	11.8	1.9
75	Cod, salt, boiled	28.8	.4	....
76	Herring, dried, salted, and smoked	20.5	8.8	....
77	Mackerel, salt, boiled	23.2	24.8	....
78	Do	22.1	33.8	....
79	Do	17.8	19.0	....
80	Do	26.2	28.0	....
81	Average, Nos. 77–79	21.0	25.9	....
82	Salmon, canned	21.8	12.1	....
	Eggs:			
83	Fresh, as purchased	13.1	9.3	....
84	Boiled, as purchased	12.4	10.7	....
85	Boiled, edible portion	14.0	12.0	....
86	Fried	13.6	19.7	....
87	Scrambled	13.4	20.5	....
88	Butterine (as butter)	1.0	85.0	....
89	Cheese	25.9	33.7	2.4
90	Cream, evaporated	9.6	9.3	11.2
91	Milk	3.3	4.0	5.0
	VEGETABLE FOOD.			
	Cereals:			
92	Hominy, boiled	1.8	1.6	16.7
93	Do	2.2	.2	21.2
94	Average, Nos. 92, 93	2.0	.9	19.0
95	Cereal, mixed, boiled	2.3	.6	11.8

TABLE 37.—*Percentage composition of foods used in the dietary studies*—Continued.

Reference No.	Kind of food.	Protein.	Fat.	Carbohydrates.
	VEGETABLE FOOD—continued.			
	Cereals—Continued.	*Per cent.*	*Per cent.*	*Per cent.*
96	Mush, corn-meal	1.3	0.3	14.0
97	Do	1.3	.4	14.8
98	Average, Nos. 96, 97	1.3	.4	14.4
99	Oatmeal, boiled	2.3	1.0	9.0
100	Do	2.8	1.2	11.1
101	Do	2.9	1.3	11.7
102	Do	2.6	1.2	10.6
103	Do	2.3	1.0	9.2
104	Average, Nos. 100, 101, 110, 111	2.8	1.2	11.2
105	Oatmeal, boiled	2.7	1.2	10.6
106	Do	2.3	1.0	9.0
107	Do	2.3	1.0	9.1
108	Do	2.9	1.4	11.8
109	Do	2.9	1.5	12.1
110	Do	2.9	1.3	11.8
111	Do	2.6	1.1	10.1
112	Average, Nos. 109, 110	2.9	1.5	12.0
113	Average, Nos. 99–103, 105–111	2.6	1.2	10.5
114	Rice, boiled	1.2	....	12.6
115	Do	1.4	....	14.0
116	Do	1.4	....	13.7
117	Do	1.0	....	10.3
118	Do	1.3	....	13.2
119	Do	1.5	....	14.4
120	Do	1.0	....	9.3
121	Do	1.0	....	9.6
122	Do	1.4	.1	14.0
123	Average, Nos. 120, 121	1.0	....	9.5
124	Average, Nos. 114–121	1.2	....	12.1
125	Shredded wheat	10.5	1.4	77.9
126	Wheat breakfast food, boiled	1.4	.1	8.6
127	Do	1.8	.4	13.7
128	Do	2.5	.4	15.6
129	Do	1.9	.3	11.4
130	Corn bread	5.1	13.9	36.0
131	Do	6.6	8.1	39.7
132	Average, Nos. 130, 131	5.9	11.0	37.9
133	Bread, biscuit, and rolls	9.2	1.3	53.1
134	Crackers, soda	9.8	9.1	73.1
135	Fritters (as bread)	9.2	1.3	53.1
136	Toast	11.5	1.6	61.2
137	Cake, bakers'	6.3	4.6	56.9
138	Cake, jelly	6.3	9.0	63.3
139	Cake, frosted	5.9	9.0	64.8
140	Doughnuts, fried	6.7	21.0	53.1
141	Gingerbread and ginger cake	5.8	9.0	63.5
142	Bread dressing (as bread)	9.2	1.3	53.1
143	Macaroni, boiled	3.3	2.1	15.8
	Sugars, etc.:			
144	Molasses	....	....	70.0
145	Sauce, pudding	2.0	18.1	75.0
146	Sugar	....	....	100.0
	Vegetables:			
147	Beans, baked	8.7	7.2	25.7
148	Do	8.8	9.8	28.3
149	Do	6.0	6.6	15.5
150	Do	9.7	6.4	25.2
151	Do	8.9	5.9	26.4
152	Average, Nos. 147–149	7.8	7.9	23.2
153	Beans, kidney, boiled	7.1	.6	18.9
154	Do	10.1	.8	26.8
155	Beans, Lima, boiled	5.6	.5	20.6
156	Beets, boiled with butter and sugar	1.7	1.1	17.0
157	Beans, boiled	1.8	.1	10.6
158	Average, 156, 157	1.8	.6	13.8
159	Cabbage, boiled	1.8	.3	6.3
160	Do	1.9	.5	7.0
161	Do	1.8	.3	6.3
162	Do	1.7	.3	6.1
163	Do	2.1	.4	7.5
164	Do	1.8	.3	6.3
165	Average, Nos. 159, 162, 163	1.9	.3	6.6
166	Average, Nos. 159–164	1.9	.4	6.6
167	Cabbage, with bacon	2.5	3.7	6.7
168	Average, Nos. 160, 164, 167	2.1	1.5	6.7
169	Celery, as purchased	.9	.1	2.6
170	Celery, edible portion	1.1	.1	3.3
171	Celery salad (as celery, edible portion)	1.1	.1	3.3
172	Corn, stewed with milk	4.0	2.5	22.6
173	Corn, stewed with butter	2.9	4.0	19.0

TABLE 37.—*Percentage composition of foods used in the dietary studies*—Continued.

Reference No.	Kind of food.	Protein.	Fat.	Carbohydrates.
	VEGETABLE FOOD—continued.			
	Vegetables—Continued.	*Per cent.*	*Per cent.*	*Per cent.*
174	Corn, stewed with milk and butter	2.5	3.7	17.1
175	Do	3.1	5.0	20.0
176	Corn, stewed with butter, sugar, and flour	3.2	2.8	25.9
177	Corn, stewed with milk and flour	2.8	1.2	16.5
178	Average, Nos. 174–176	2.9	3.8	21.0
179	Average, Nos. 172–177	3.1	3.2	20.2
180	Egg plant, cooked	6.4	24.5	32.5
181	Kale, boiled (as cabbage, boiled)	1.4	3.8	5.0
182	Lettuce	1.2	.3	2.9
183	Onions, green	1.0	.1	11.2
184	Onions, boiled	1.2	1.8	4.9
185	Onions, fried	1.0	25.0	11.0
186	Parsnips, boiled and browned	2.0	6.6	16.5
187	Peas, canned, stewed	4.3	.3	11.7
188	Peas, canned, stewed with butter and sugar	3.4	1.7	11.6
189	Average, Nos. 187, 188	3.9	1.0	11.7
190	Pickles, cucumber	.5	.3	2.7
191	Potatoes, baked, as purchased	2.3	....	19.2
192	Do	2.0	....	16.5
193	Do	2.4	.2	19.1
194	Do	3.0	.3	24.3
195	Do	2.3	.1	19.1
196	Do	2.2	.2	17.6
197	Do	2.4	....	20.4
198	Do	2.9	.3	23.1
199	Do	2.3	.1	18.4
200	Do	3.0	....	24.0
201	Do	2.3	....	18.9
202	Do	2.3	.1	19.0
203	Average, Nos. 191–202	2.5	.1	20.0
204	Potatoes, baked, edible portion (as boiled and browned)	2.5	.1	20.8
205	Potatoes, steamed, as purchased	1.8	.1	14.9
206	Do	1.9	.1	15.1
207	Average, Nos. 205, 206	1.9	.1	15.0
208	Potatoes, steamed, edible portion	2.2	....	19.3
209	Do	2.5	....	20.9
210	Average, Nos. 208, 209	2.4	....	20.1
211	Potatoes, boiled, edible portion	2.2	....	18.9
212	Do	2.2	.1	18.4
213	Average, Nos. 208, 209, 211, 212	2.3	....	19.4
214	Potatoes, boiled and browned	2.4	.1	19.6
215	Do	3.0	.2	25.4
216	Do	2.1	.1	17.4
217	Average, Nos. 214–216	2.5	.1	20.8
218	Potatoes, fried	2.3	6.9	21.1
219	Do	2.2	6.2	21.4
220	Do	2.6	10.9	21.3
221	Do	2.7	9.3	22.0
222	Average, Nos. 218–221	2.5	8.3	21.5
223	Potatoes, hashed	2.6	....	25.8
224	Potatoes, mashed and creamed	2.4	2.3	15.7
225	Do	2.4	2.2	15.8
226	Do	2.5	2.9	15.9
227	Do	2.7	4.2	19.8
228	Do	2.6	3.0	20.2
229	Average, Nos. 227, 228	2.7	3.6	20.0
230	Average, Nos. 224–228	2.5	2.9	17.5
231	Potato cakes	2.0	5.5	17.5
232	Potato salad (as potatoes, boiled, edible portion)	2.3	....	19.4
233	Saratoga chips	6.8	39.8	46.7
234	Rhubarb, stewed	.5	.6	23.1
235	Sauerkraut	1.7	.5	3.8
236	Slaw	1.6	.3	5.6
237	Soup, bean	2.1	.2	6.8
238	Do	2.1	.2	6.5
239	Average, Nos. 237, 238	2.1	.2	6.7
240	Soup, corn	1.3	2.2	2.8
241	Soup, pea	3.6	.7	7.6
242	Soup, potato	1.5	2.1	4.8
243	Soup, tomato	.3	.5	4.2
244	Do	.3	.5	5.4
245	Average, Nos. 243, 244	.3	.5	4.8
246	Soup, vegetable	.7	.1	4.2
247	Do	.6	.1	4.1
248	Do	.7	....	5.2
249	Do	1.0	....	8.0
250	Do	.6	....	10.3
251	Do	.5	....	4.0
252	Average, Nos. 248, 249	.9	....	6.6
253	Average, Nos. 246–251	.7	....	6.0

Table 37.—*Percentage composition of foods used in the dietary studies*—Continued.

Reference No.	Kind of food.	Protein.	Fat.	Carbohydrates.
	VEGETABLE FOOD—continued.			
	Vegetables—Continued.	*Per cent.*	*Per cent.*	*Per cent.*
254	Squash, boiled	1.9	0.7	12.2
255	Succotash	4.2	2.1	19.6
256	Sweet potato, baked, as purchased	2.3	.6	28.6
257	Sweet potato, baked, edible portion	2.4	5.9	35.9
258	Sweet potato, boiled (as raw)	1.4	.6	21.9
259	Sweet potato, boiled and browned	2.4	5.9	35.1
260	Do	1.9	2.6	34.3
261	Average, Nos. 259, 260	2.2	4.3	34.7
262	Sweet potato roll	1.8	4.5	28.7
263	Sauce, tomato, stewed	1.8	.4	22.2
264	Do	1.8	.4	28.7
265	Average, Nos. 263, 264	1.8	.4	25.5
266	Tomatoes, stewed	1.7	1.4	15.0
267	Do	1.4	1.4	10.1
268	Average, Nos. 266, 267	1.6	1.4	12.6
269	Turnips, boiled and mashed	1.5	.2	9.1
270	Do	1.3	.2	8.1
	Fruits, etc.:			
271	Apples, as purchased	.3	.3	10.8
272	Apples, baked with sugar	.4	.5	22.9
273	Do	.3	.3	17.0
274	Do	.3	.3	15.0
275	Average, Nos. 273, 274	.3	.3	16.0
276	Average, Nos. 272–274	.3	.4	18.3
277	Apples, fried	4.2	.8	26.0
278	Apple butter	.5	....	47.2
279	Bananas, as purchased	.8	.4	14.3
280	Bananas, edible portion	1.3	.6	22.0
281	Grapes, as purchased	1.0	1.2	14.4
282	Oranges, as purchased	.6	.1	8.5
283	Pears, stewed	.4	.4	21.1
284	Do	.4	.4	25.5
285	Average, Nos. 283, 284	.4	.4	23.3
286	Prunes, stewed	.7	....	41.3
287	Do	.7	....	37.1
288	Do	.8	....	43.0
289	Do	.9	....	42.3
290	Do	.7	....	34.3
291	Average, Nos. 286–289	.8	....	40.9
292	Jelly, apple	.3	....	70.0
293	Jelly, currant	.4	....	64.0
294	Sauce, apple	.2	.2	27.4
295	Do	.4	.5	27.0
296	Do	.2	.3	19.2
297	Do	.4	.4	35.7
298	Do	.6	.6	34.1
299	Do	.3	.3	23.5
300	Sauce, apple, evaporated	.4	.5	30.3
301	Average, Nos. 297–299	.4	.4	31.1
302	Average, Nos. 294–299	.4	.4	27.8
303	Sauce, cranberry	....	....	30.5
304	Sauce, peach, evaporated	2.3	.5	37.3
305	Do	1.4	.3	26.2
306	Do	1.6	.3	34.0
307	Average, Nos. 304, 305	1.9	.4	31.8
	MISCELLANEOUS FOOD.			
308	Hash, baked	12.6	10.1	10.3
309	....do	11.7	24.0	9.7
310	Liver and bacon	25.8	40.2	.8
311	Meat pie	8.1	21.6	16.6
312	Stew, beef	10.2	11.1	8.5
313	....do	9.8	8.7	8.0
314	....do	9.6	8.6	3.4
315	....do	10.1	8.5	8.1
316	Average, Nos. 312–315	9.9	9.2	7.0
317	Stew, mutton	8.2	7.3	8.4
318	Codfish cakes	19.4	9.8	15.3
319	Chicken, creamed, edible portion	7.0	6.3	3.1
320	Chicken, baked and stuffed	21.8	10.9	3.8
321	Oysters, creamed	4.7	6.5	6.3
322	Oysters, scalloped	7.6	13.8	33.3
323	Oysters, stewed	4.0	3.8	4.0
324	Average, Nos. 321–323	4.4	5.2	5.2
325	Soup, clam (as soup, oyster)	2.5	2.5	3.6
326	Soup, oyster	2.5	2.5	3.6
327	Omelet, ham (as scrambled eggs)	13.4	20.5	....
328	Sauce, for halibut	4.3	9.6	5.3
329	Gravy, for steak	1.4	8.3	5.5

TABLE 37.—*Percentage composition of foods used in the dietary studies*—Continued.

Reference No.	Kind of food.	Protein.	Fat.	Carbohydrates.
	MISCELLANEOUS FOOD—continued.			
		Per cent.	*Per cent.*	*Per cent.*
330	Gravy, for beef	....	....	1.1
331	Griddle cakes	6.5	2.3	37.2
332	Hominy and beans	4.7	.9	21.6
333	Macaroni and cheese, baked	7.4	6.4	16.6
334	Macaroni and tomatoes, boiled	3.5	.5	19.2
335	Muffins	9.9	15.6	38.9
336	Custard, plain	5.6	5.0	16.7
337	Custard, chocolate	4.5	4.9	16.3
338	Custard sauce	4.9	4.2	15.9
339	Dumplings, apple (as apple pie)	3.1	9.8	42.8
340	Ice cream, caramel	3.9	4.0	21.1
341	Ice, lemon	.8	....	82.4
342	Jelly, lemon	3.1	....	17.6
343	Onions, creamed (as onions boiled)	1.2	1.8	4.9
344	Pie, apple	1.9	6.7	29.0
345	Pie, apple, evaporated	3.1	9.8	42.8
346	Pie, custard	4.2	6.3	26.1
347	Pie, lemon	3.6	10.1	37.4
348	Pie, mince	5.8	12.3	38.1
349	Pie, peach, evaporated	3.4	17.6	38.5
350	Pie, rhubarb	2.8	11.6	27.0
351	.....do	3.1	9.8	42.8
352	Pie, squash	4.4	8.4	21.7
353	Pudding, bread	2.6	2.3	22.1
354	Pudding, chocolate	3.2	4.9	21.3
355	.....do	2.9	5.8	24.6
356	Average, Nos. 354, 355	3.1	5.4	23.0
357	Pudding, cornstarch	3.0	.7	33.9
358	Pudding, cottage (as cake)	6.3	4.6	56.9
359	Pudding, cottage	6.7	11.1	60.0
360	Pudding, floating island	4.6	4.6	15.8
361	.....do	4.7	4.4	22.4
362	Average, Nos. 360, 361	4.7	4.5	19.1
363	Pudding, junket	2.6	2.9	12.3
364	Pudding, rice	3.8	3.3	16.2
365	.....do	4.1	3.4	22.7
366	Pudding, steamed	4.9	8.9	54.2
367	.....do	4.3	5.5	55.5
368	Pudding, tapioca	3.3	3.2	28.2
369	Sauce, lemon, for pudding	2.1	1.6	19.0
370	Sauce, for pudding	.9	4.7	14.0
371	.....do	5.0	3.8	16.3
372	Sauce, for pudding (as milk)	3.3	4.0	5.0

STATISTICS FOR COMPUTING THE PERCENTAGE COMPOSITION OF THE COOKED FOODS USED IN THE DIETARY STUDIES.

It has been explained (p. 15) that in lieu of actual analyses, which it was not practicable to make in connection with these studies, the percentage composition of each cooked food used during the studies was computed from the total weight of the cooked material and the weight and assumed composition of each raw ingredient used. The method of making such computations for each of the various classes of cooked foods is explained in detail in Tables 1, 2, and 3 and the text accompanying them. The figures for the percentage composition of the different materials as thus computed are given in Table 37 above. The data regarding the total weight of the cooked material, the weight and assumed composition of the raw ingredients, the weights of fat and bone removed, etc., from which the figures in Table 37 were computed, are given in Table 38 below. The observer's notes regarding the character and quality of the raw materials were essential for a proper estimation of the percentage composition, but these are not given as they were very voluminous.

In connection with the explanation of the method of computation given on pages 15 to 15, just referred to, a few remarks here will, it is believed, make the data in the table clear.

The figures in the column headed "Reference No." correspond with those in Table 37, their purpose being to indicate the data in Table 38 that were used in computing the composition of any given cooked article in Table 37. For instance, No. 2 of Table 37 is beef, boiled, "as purchased," the composition of which is given as 18.6 per cent protein and 22.8 per cent fat. By referring to Table 38 it will be seen that the total weight of the cooked meat was 258.5 pounds, and that of the uncooked meat was 325 pounds. The observer's notes showed that this consisted of medium fat beef side, "as purchased," the composition of which was assumed from the average of several analyses to be protein 14.8 per cent and fat 18.1 per cent. Following the method of calculation explained on page 16, the total amount of protein in the uncooked meat was found to be 48.1 pounds and of fat 58.8 pounds. Dividing these quantities by the weight of the cooked meat gives 18.6 per cent of protein and 22.8 per cent fat in the cooked meat, the composition recorded in Table 37.

The terms "as purchased" and "edible portion" used in the tables are common in accounts of dietary studies, and serve to indicate the condition of the food materials as regards the presence or absence of refuse, i. e., inedible material, such as the skins and seeds of vegetables, the bone of meat, the shell of eggs, etc. If the food material when weighed contained such inedible material, the term "as purchased" is used in the record; whereas if the inedible material or refuse had been removed before the weight was taken the term "edible portion" is used. Thus, in the case of item No. 2 of Table 38, discussed above, "beef side, as purchased, 325 pounds," indicates that the bones were still in the meat; whereas in the case of No. 4 the statement, "beef, boiled, edible portion, 17.5 pounds," indicates an amount of food material not containing refuse.

Information concerning the refuse is necessary in estimating the percentage composition which should be used to compute the nutrients furnished by any given food material. This will be clear from a consideration of item No. 4. A part of beef No. 2, namely 29 pounds, was used to feed a certain group, but before serving, the bones were removed and only the edible portion, 17.5 pounds, was placed on the table. It was necessary therefore to ascertain the composition of the edible portion alone in order to calculate the quantities of nutrients in the amounts eaten. The computation of the composition in this case was exactly the same as that explained just above for beef No. 2. The quantities of protein and fat in the 29 pounds of beef, which still contained bone, were calculated by the use of the figures for the composition of beef No. 2 (Table 37) from which it was taken, and these were divided by the total amount of edible material, 17.5 pounds. The resulting figures were the percentage composition of edible portion given for beef No. 4 in Table 37.

It will be observed that in some cases the figures in the column of Table 38 headed "Weight of ingredients" are those for materials to be deducted in computing composition. For instance, in the case of No. 8, allowance is made in computing the composition of beef "edible portion" from beef "as purchased" for fat cooked out of the meat and for bones removed after cooking. This is fully explained in the discussion on page 16.

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies.*

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
1	Beef, boiled, as purchased	24.50	11.11					
	Beef, brisket and plate, as purchased			28.75	13.04	12.9	23.4	
2	Beef, boiled, as purchased	258.50	117.26					
	Beef, side, as purchased			325.00	147.42	14.8	18.1	
4	Beef, boiled, edible portion	17.50	7.94					
	Beef, boiled, from lot No. 2			29.00	13.15	18.6	22.8	
	Bones removed			11.50	5.22			
5	Beef, boiled, edible portion	87.75	39.80					
	Beef, shins, brisket, and neck, as purchased			142.10	64.46	18.8	18.9	
6	Beef, boiled, edible portion	63.00	28.58					
	Beef, plate, neck, clod, and shin, edible portion			104.25	47.29	19.2	17.1	
7	Beef, boiled, edible portion	163.25	74.05					
	Beef, plate, brisket, and chuck, edible portion			232.30	105.37	16.9	25.2	
8	Beef, boiled, edible portion	364.00	165.11					
	Beef, neck, shin, and clod, as purchased			650.00	294.84	15.1	13.1	
	Fat cooked out			16.00	7.26		100.0	
	Bones removed after cooking			81.00	36.74			
10	Liver, fried	10.50	4.76					
	Liver			12.75	5.78	20.7	4.5	1.5
	Flour			3.75	1.70	11.4	1.0	75.1
	Butter			.75	.34	1.0	85.0	
	Fat for frying			2.65	1.20		100.0	
	Fat remaining after cooking			1.50	.68		100.0	
11	Liver, fried	45.75	20.75					
	Liver			57.50	26.08	20.7	4.5	1.5
	Fat for frying			4.50	2.04		100.0	
12	Beef, roast, as purchased	25.14	11.40					
	Beef, chuck, as purchased			37.75	17.12	15.5	15.0	
13	Beef, roast, as purchased	20.50	9.30					
	Beef, chuck and brisket, as purchased			32.25	14.63	14.3	16.2	
14	Beef, roast, as purchased	428.00	194.14					
	Beef, side, as purchased			600.00	272.16	14.8	18.1	
	Fat cooked out			15.50	7.03.		100.0	
16	Beef, roast, edible portion	116.50	52.84					
	Beef, rib, chuck, and plate, edible portion			173.50	78.70	17.5	24.6	
17	Beef, roast, edible portion	373.00	169.19					
	Beef, cooked, as purchased (same lot as No. 14)			428.00	194.14	20.7	21.8	
	Bones removed after cooking			55.00	24.95			
18	Beefsteak, fried, edible portion	14.00	6.35					
	Beef, rib, edible portion			18.75	8.51	17.5	26.6	
	Lard for frying			1.00	.45		100.0	
	Fat remaining after frying			.75	.34		100.0	
19	Beefsteak, fried, edible portion	17.00	7.71					
	Beef, rib, edible portion			22.00	9.98	17.5	26.6	
20	Beefsteak, fried, edible portion	16.25	7.37					
	Beef, sirloin and rib, edible portion			19.00	8.62	18.2	22.6	
21	Beefsteak, fried, edible portion	14.75	6.69					
	Beef, sirloin, edible portion			20.50	9.30	18.9	18.5	
	Lard for frying			.30	.14		100.0	
22	Beefsteak, fried, as purchased	26.25	11.91					
	Beef, round, as purchased			36.25	16.44	19.0	12.8	
23	Beefsteak, fried, as purchased	23.00	10.43					
	Beef, round and sirloin, as purchased			31.25	14.18	17.6	15.2	
	Lard for frying			1.75	.79		100.0	
24	Beefsteak, fried, edible portion	91.50	41.50					
	Beef, round, edible portion			136.00	61.69	20.3	13.6	
28	Beef:							
	Corned, boiled, edible portion	401.50	182.12					
	Beef, corned, cooked, as purchased, lot No. 31			515.50	233.83	22.9	17.8	
	Bones removed after cooking			114.00	51.71			
29	Beef:							
	Corned, boiled, as purchased	254.25	115.33					
	Beef, corned, as purchased			360.00	163.30	15.6	26.2	

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
29	Beef, corned, boiled, edible portion, from lot above	27.50	12.47					
	Beef, corned, boiled, as purchased			38.75	17.58	22.1	37.1	
	Bone and refuse			11.25	5.10			
30	Beef, corned, boiled, edible portion	135.50	61.46					
	Beef, corned, edible portion			260.00	117.94	15.6	26.2	
31	Beef, corned, boiled, as purchased	515.50	233.83					
	Beef, corned, side, as purchased			799.00	362.43	14.8	18.1	
	Fat cooked out			56.00	25.40		100.0	
33	Beef, dried, stewed	21.0..	9.53					
	Beef, dried, canned			4.00	1.81	39.2	5.4	
	Milk			9.50	4.31	3.3	4.0	5.0
	Butter			.40	.18	1.0	85.0	
	Flour			1.00	.45	11.4	1.0	75.1
34	Beef, dried, stewed	4.50	2.04					
	Beef, dried, canned			2.50	1.13	39.2	5.4	
	Butter			.95	.43	1.0	85.0	
36	Veal cutlets, fried, edible portion	16.00	7.26					
	Veal cutlets, edible portion			21.00	9.53	20.3	7.7	
	Butter			1.25	.57	1.0	85.0	
38	Lamb, roast, as purchased	23.25	10.55					
	Lamb, leg, as purchased			33.75	15.31	15.9	13.6	
42	Pork, chops, fried, as purchased	26.25	11.91					
	Pork chops, as purchased			43.75	19.85	13.4	24.2	
	Fat for frying			4.25	1.93		100.0	
	Flour			4.25	1.93	11.4	1.0	75.1
	Fat remaining after frying			7.50	3.40		100.0	
43	Pork, feet, boiled, as purchased	77.00	34.93					
	Pork, feet, as purchased			102.00	46.27	4.1	6.9	
45	Pork, baked, as purchased	31.00	14.06					
	Pork, loin, as purchased			50.50	22.91	13.4	24.2	
	Fat cooked out			4.00	1.81		100.0	
46	Pork, jowl, boiled, edible portion	179.50	81.42					
	Pork, jowls, as purchased			325.00	147.42			
	Bones, raw[a]			81.10	36.79			
	Pork, jowls, edible portion			243.90	110.63	13.4	41.3	
	Fat cooked out (estimated)			10.00	4.54		100.0	
47	Pork, roast, edible portion	85.00	38.56					
	Pork, ribs, as purchased			175.00	79.38	13.4	24.2	
	Fat cooked out			24.00	10.89		100.0	
48	Pork, bacon, fried, edible portion	3.50	1.59					
	Pork, bacon, fat, edible portion			8.00	3.63	9.9	67.4	
	Fat cooked out			4.00	1.81		100.0	
49	Pork, bacon, fried, as purchased	7.50	3.40					
	Pork, bacon, as purchased			18.75	8.51	9.1	62.2	
	Fat cooked out			6.50	2.95		100.0	
50	Pork, bacon, fried, edible portion	34.25	15.54					
	Pork, bacon, edible portion			69.00	31.30	9.9	67.4	
	Fat cooked out			25.50	11.57		100.0	
53	Pork, ham, fried, as purchased	12.25	5.56					
	Pork, ham, sliced, as purchased			18.25	8.28	14.2	33.4	
	Fat cooked out			2.50	1.13		100.0	
55	Pork, shoulders, smoked, boiled, as purchased	686.00	311.17					
	Pork, shoulders, smoked, as purchased			900.00	408.24	13.0	26.6	
	Fat cooked out			54.50	24.72		100.0	
56	Pork, shoulders, smoked, edible portion	172.00	78.02					
	Pork, shoulders, smoked, edible portion			245.00	111.13	15.9	32.5	
	Fat removed			10.00	4.54		100.0	
57	Pork, shoulders, smoked, boiled, edible portion	507.00	229.98					
	Pork, shoulders (same lot as No. 55), cooked, as purchased			686.00	311.17	17.1	27.0	
	Bones			91.00	41.28			
	Skins, removed			88.00	39.92	15.4	53.7	
58	Pork, sausage, fried, as purchased	35.50	16.10					
	Pork, sausage, as purchased			61.75	28.01	13.0	44.2	1.1
	Fat cooked out			10.00	4.54		100.0	
59	Pork, sausage, fried, as purchased	16.50	7.48					
	Pork, sausage, as purchased			20.75	9.41	13.0	44.2	1.1
	Lard, for frying			.35	.16		100.0	
	Fat cooked out			1.50	.68		100.0	
60	Pork, sausage, fried, as purchased	86.50	39.24					
	Pork, sausage, as purchased			140.75	63.84	13.0	44.2	1.1
	Fat cooked out			3.25	1.47		100.0	

[a] Estimated from the weight of cooked bones. The loss in cooking is estimated as 10 per cent.

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
61	Pork, sausage, fried, as purchased	287.00	130.18					
	Pork, sausage, as purchased			544.00	246.76	13.0	44.2	1.1
	Fat cooked out			68.00	30.85		100.0	
64	Pork, gravy, cooked	11.25	5.10					
	Pork, fat, from cooking pork			4.00	1.81		100.0	
	Flour			.75	.34	11.4	1.0	75.1
65	Pork, gravy, cooked	8.75	3.97					
	Pork, fat, from cooking pork			2.50	1.13		100.0	
	Flour			.50	.23	11.4	1.0	75.1
66	Chicken, fricasseed, as purchased	34.00	15.42					
	Chicken, as purchased			25.50	11.57	13.7	12.3	
	Onions, edible portion			1.50	.68	1.6	.3	9.9
	Flour			1.10	.50	11.4	1.0	75.1
67	Chicken, stewed, edible portion	34.00	15.42					
	Chicken, edible portion			21.25	9.64	19.3	16.3	
	Butter			.50	.23	1.0	85.0	
68	Cod, baked, dressed	135.00	61.24					
	Cod, dressed, as purchased			156.75	71.10	11.1	.2	
69	Cod, scalloped	28.25	12.81					
	Cod, salt, edible portion			24.50	11.11	21.5	.3	
	Milk			5.65	2.56	3.3	4.0	5.0
	Butter			.25	.11	1.0	85.0	
	Bread			2.00	.91	9.2	1.3	53.1
	Flour			1.25	.57	11.4	1.0	75.1
70	Cod, stuffed, baked	27.50	12.47					
	Cod, fresh, dressed, as purchased			32.75	14.86	11.1	.2	
	Bread			1.75	.79	9.2	1.3	53.1
	Butter			1.00	.45	1.0	85.0	
	Flour			.25	.11	11.4	1.0	75.1
	Fat for cooking			6.50	2.95		100.0	
71	Halibut, boiled	26.25	11.91					
	Halibut, dressed, edible portion			32.00	14.52	18.6	5.2	
72	Haddock, baked	389.00	176.45					
	Haddock, dressed, edible portion			403.00	182.80	8.4	.2	
	Bread, dried			14.00	6.35	9.2	1.3	53.1
	Fat for baking			45.00	20.41		100.0	
73	Herring, dressed, fried	396.75	179.97					
	Herring, dressed, edible portion			533.50	242.00	19.5	7.1	
	Fat for frying			75.00	34.02		100.0	
	Flour			32.25	14.63	11.4	1.0	75.1
75	Cod, salt, boiled	209.00	94.80					
	Cod, salt, edible portion			280.00	127.01	21.5	.3	
77	Mackerel, salt, boiled	11.75	5.33					
	Mackerel, salt, entrails removed			16.75	7.60	16.3	17.4	
78	Mackerel, salt, boiled	88.75	40.26					
	Mackerel, salt, edible portion			113.50	51.48	17.3	26.4	
79	Mackerel, salt, boiled	15.75	7.14					
	Mackerel, salt, entrails removed			17.25	7.82	16.3	17.4	
80	Mackerel, salt, fried	280.00	127.01					
	Mackerel, salt, entrails removed			450.00	204.12	16.3	17.4	
86	Eggs, fried	14.75	6.69					
	Eggs, edible portion			13.25	6.01	14.8	10.5	
	Fat for frying			1.50	.68		100.0	
87	Eggs, scrambled	16.00	7.26					
	Eggs, edible portion			14.50	6.58	14.8	10.5	
	Lard for cooking			1.75	.79		100.0	
92	Hominy, boiled	117.25	53.18					
	Hominy			24.75	11.23	8.3	.6	79.0
	Butter			2.00	.91	1.0	85.0	
93	Hominy, boiled	106.00	48.08					
	Hominy			28.50	12.93	8.3	.6	79.0
95	Cereal, mixed, boiled	29.75	13.49					
	Wheat breakfast food and oatmeal mixed			5.00	2.27	11.3	4.6	70.0
96	Mush (corn-meal, boiled)	28.00	12.70					
	Corn meal			5.00	2.27	7.1	1.3	78.4
97	Mush (corn-meal, boiled)	22.25	10.09					
	Corn meal			4.25	1.93	7.1	1.3	78.4
99	Oatmeal, boiled	95.75	43.43					
	Oats, rolled			13.00	5.90	16.7	7.3	66.2
100	Oatmeal, boiled	148.75	67.47					
	Oats, rolled			25.00	11.34	16.7	7.3	66.2
101	Oatmeal, boiled	124.75	56.59					
	Oats, rolled			22.00	9.98	16.7	7.3	66.2
102	Oatmeal, boiled	26.50	12.02					
	Oats, rolled			4.25	1.93	16.7	7.3	66.2

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
103	Oatmeal, boiled	27.00	12.25					
	Oats, rolled			3.75	1.70	16.7	7.3	66.2
105	Oatmeal, boiled	26.50	12.02					
	Oats, rolled			4.25	1.93	16.7	7.3	66.2
106	Oatmeal, boiled	24.00	10.89					
	Oats, rolled			3.25	1.47	16.7	7.3	66.2
107	Oatmeal, boiled	25.50	11.57					
	Oats, rolled			3.50	1.59	16.7	7.3	66.2
108	Oatmeal, boiled	28.00	12.70					
	Oats, rolled			5.00	2.27	16.7	7.3	66.2
109	Oatmeal, boiled	27.25	12.36					
	Oats, rolled			5.00	2.27	16.7	7.3	66.2
110	Oatmeal, boiled	119.25	54.09					
	Oats, rolled			21.25	9.64	16.7	7.3	66.2
111	Oatmeal, boiled	153.50	69.63					
	Oats, rolled			23.50	10.66	16.7	7.3	66.2
114	Rice, boiled	22.00	9.98					
	Rice			3.50	1.59	8.0	.3	79.0
115	Rice, boiled	25.50	11.57					
	Rice			4.50	2.04	8.0	.3	79.0
116	Rice, boiled	26.00	11.79					
	Rice			4.50	2.04	8.0	.3	79.0
117	Rice, boiled	23.00	10.43					
	Rice			3.00	1.36	8.0	.3	79.0
118	Rice, boiled	25.50	11.57					
	Rice			4.25	1.93	8.0	.3	79.0
119	Rice, boiled	26.00	11.79					
	Rice			4.75	2.15	8.0	.3	79.0
120	Rice, boiled	30.00	13.61					
	Rice			3.50	1.59	8.0	.3	79.0
121	Rice, boiled	29.25	13.27					
	Rice			3.50	1.59	8.0	.3	79.0
122	Rice, boiled	395.00	179.17					
	Rice			70.00	31.75	8.0	.3	79.0
126	Wheat breakfast food, boiled	26.25	11.91					
	Wheat breakfast food			3.00	1.36	12.4	1.0	75.8
127	Wheat breakfast food, boiled	27.75	12.59					
	Wheat breakfast food			5.00	2.27	10.9	1.9	76.2
128	Wheat breakfast food, boiled	27.50	12.47					
	Wheat breakfast food			5.75	2.61	12.3	1.8	74.2
129	Wheat breakfast food, boiled	489.25	221.92					
	Wheat breakfast food			75.00	34.02	12.3	1.8	74.2
130	Corn bread	27.25	12.36					
	Corn meal			11.50	5.22	7.1	1.3	78.4
	Milk			6.50	2.95	3.3	4.0	5.0
	Lard			3.00	1.36		100.0	
	Eggs, as purchased			2.75	1.25	13.1	9.3	
	Sugar			.50	.23			100.0
131	Corn bread	36.75	16.67					
	Milk			18.50	8.39	3.3	4.0	5.0
	Eggs, as purchased			3.00	1.36	13.1	9.3	
	Flour			4.75	2.15	11.4	1.0	75.1
	Lard			1.75	.79		100.0	
	Corn meal			12.25	5.56	7.1	1.3	78.4
	Sugar			.50	.23			100.0
143	Macaroni and tomatoes, boiled	369.00	167.38					
	Macaroni			75.00	34.02	13.4	.9	74.1
	Tomatoes, canned			67.50	30.62	1.2	.2	4.0
	Butter			6.00	2.72	1.0	85.0	
	Cheese			5.00	2.27	25.9	33.7	2.4
145	Sauce for pudding	9.50	4.31					
	Sugar			6.00	2.72			100.0
	Butter			2.00	.91	1.0	85.0	
	Flour			1.50	.68	11.4	1.0	75.1
147	Beans, baked	191.00	86.64					
	Beans, pea white, dried			72.75	33.00	22.5	1.8	59.6
	Pork, salt			14.50	6.58	1.9	86.2	
	Molasses			8.25	3.74			70.0
148	Beans, baked	152.00	68.95					
	Beans, pea white, dried			58.25	26.42	22.5	1.8	59.6
	Pork, salt			16.00	7.26	1.9	86.2	
	Molasses			11.75	5.34			70.0
149	Beans, baked	130.00	58.97					
	Beans, pea white, dried			33.75	15.34	22.5	1.8	59.6
	Pork, salt			9.25	4.20	1.9	86.2	
150	Beans, baked	461.00	209.11					
	Beans, pea white, dried			195.00	88.45	22.5	1.8	59.6
	Pork, salt			30.00	13.61	1.9	86.2	

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
151	Beans, baked	502.00	227.71					
	Beans, pea white, dried			195.00	88.45	22.5	1.8	59.6
	Pork, salt			30.00	13.61	1.9	86.2	
	Molasses			23.00	10.43			70.0
153	Beans, kidney, boiled	411.00	186.43					
	Beans, kidney, dried			130.00	58.97	22.5	1.8	59.6
154	Beans, kidney, boiled	37.75	17.12					
	Beans, kidney, dried			17.00	7.71	22.5	1.8	59.6
155	Beans, lima, boiled	416.00	188.70					
	Beans, lima, dried			130.00	58.97	18.1	1.5	65.9
156	Beets, boiled, edible portion	17.65	8.01					
	Beets, as purchased			23.25	10.55	1.3	.1	7.7
	Refuse			4.75	2.15			
	Butter			.25	.11	1.0	85.0	
	Sugar			1.15	.52			100.0
157	Beets, boiled, edible portion	152.00	68.95					
	Beets, edible portion			166.50	75.52	1.6	.1	9.7
159	Cabbage, boiled	202.50	91.85					
	Cabbage			228.25	103.53	1.6	.3	5.6
160	Cabbage, boiled	41.25	18.71					
	Cabbage			52.50	23.81	1.6	.3	5.6
161	Cabbage, boiled	40.00	18.14					
	Cabbage			44.00	19.96	1.6	.3	5.6
162	Cabbage, boiled	189.25	85.84					
	Cabbage			205.25	93.10	1.6	.3	5.6
163	Cabbage, boiled	168.00	76.21					
	Cabbage			224.50	101.83	1.6	.3	5.6
164	Cabbage, boiled	83.25	37.76					
	Cabbage			94.00	42.64	1.6	.3	5.6
167	Cabbage, boiled with bacon	40.25	18.26					
	Cabbage			48.75	22.11	1.6	.3	5.6
	Bacon, as purchased			2.25	1.02	9.1	62.2	
172	Corn, stewed	10.25	4.65					
	Corn, canned			11.40	5.17	2.8	1.2	19.0
	Milk			3.00	1.36	3.3	4.0	5.0
173	Corn, stewed	15.25	6.92					
	Corn, canned			15.25	6.92	2.8	1.2	19.0
	Butter			.50	.23	1.0	85.0	
174	Corn, stewed	24.50	11.11					
	Corn, canned			21.50	9.75	2.8	1.2	19.0
	Milk			1.75	.79	3.3	4.0	5.0
	Butter			.60	.27	1.0	85.0	
175	Corn, stewed	26.00	11.79					
	Corn, canned			22.00	9.98	2.8	1.2	19.0
	Milk			2.25	1.02	3.3	4.0	5.0
	Butter			1.00	.45	1.0	85.0	
	Flour			1.25	.57	11.4	1.0	75.1
176	Corn, stewed	24.75	11.23					
	Corn, canned			23.75	10.77	2.8	1.2	19.0
	Butter			.50	.23	1.0	85.0	
	Sugar			1.00	.45			100.0
	Flour			1.25	.57	11.4	1.0	75.1
177	Corn, stewed	138.75	62.94					
	Corn, canned			84.50	38.33	2.8	1.2	19.0
	Cream, evaporated			5.90	2.68	9.6	9.3	11.2
	Flour			8.25	3.74	11.4	1.0	75.1
180	Eggplant, fried	86.50	39.24					
	Eggplant, edible portion			156.50	70.99	1.2	.3	5.1
	Fat for cooking			26.75	12.13		100.0	
	Flour			26.50	12.02	11.4	1.0	75.1
	Eggs, edible portion			2.50	1.13	14.8	10.5	
	Cream, evaporated			2.25	1.02	9.6	9.3	11.2
	Fat after cooking			6.75	3.06		100.0	
181	Kale, boiled	113.00	51.26					
	Kale (as cabbage)			100.00	45.36	1.6	.3	5.6
	Fat for cooking			4.00	1.81		100.0	
185	Onions, fried	455.00	206.39					
	Onions, edible portion			456.00	206.84	1.0	.1	11.2
	Fat for frying			114.00	51.71		100.0	
186	Parsnips, boiled and browned	15.75	7.14					
	Parsnips, edible portion			19.25	8.73	1.6	.5	13.5
	Butter			1.10	.50	1.0	85.0	
187	Peas, stewed	15.25	6.92					
	Peas, canned			18.25	8.28	3.6	.2	9.8
188	Peas, stewed	23.25	10.55					
	Peas, canned			22.75	10.32	3.6	.2	9.8
	Butter			.35	.16	1.0	85.0	
	Sugar			.50	.23			100.0

Table 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
191	Potatoes, baked, as purchased	27.25	12.36					
	Potatoes, as purchased			35.50	16.10	1.8	0.1	14.7
192	Potatoes, baked, as purchased	4.00	1.81					
	Potatoes, as purchased			4.50	2.04	1.8	.1	14.7
193	Potatoes, baked, as purchased	4.25	1.93					
	Potatoes, as purchased			5.50	2.50	1.8	.1	14.7
194	Potatoes, baked, as purchased	3.50	1.59					
	Potatoes, as purchased			5.75	2.61	1.8	.1	14.7
195	Potatoes, baked, as purchased	24.50	11.11					
	Potatoes, as purchased			31.75	14.40	1.8	.1	14.7
196	Potatoes, baked, as purchased	5.00	2.27					
	Potatoes, as purchased			6.00	2.72	1.8	.1	14.7
197	Potatoes, baked, as purchased	2.50	1.13					
	Potatoes, as purchased			3.50	1.59	1.8	.1	14.7
198	Potatoes, baked, as purchased	3.50	1.59					
	Potatoes, as purchased			5.50	2.50	1.8	.1	14.7
199	Potatoes, baked, as purchased	29.25	13.27					
	Potatoes, as purchased			36.75	16.67	1.8	.1	14.7
200	Potatoes, baked, as purchased	2.00	.91					
	Potatoes, as purchased			3.25	1.47	1.8	.1	14.7
201	Potatoes, baked, as purchased	3.50	1.59					
	Potatoes, as purchased			4.50	2.04	1.8	.1	14.7
202	Potatoes, baked, as purchased	30.50	13.84					
	Potatoes, as purchased			39.50	17.92	1.8	.1	14.7
205	Potatoes, boiled, as purchased	149.75	67.93					
	Potatoes, as purchased			151.50	68.72	1.8	.1	14.7
206	Potatoes, boiled, as purchased	175.00	79.38					
	Potatoes, as purchased			179.50	81.42	1.8	.1	14.7
208	Potatoes, steamed, edible portion	27.00	12.25					
	Potatoes, edible portion			28.25	12.81	2.2	.1	18.4
209	Potatoes, steamed, edible portion	27.75	12.59					
	Potatoes, edible portion			31.75	14.40	2.2	.1	18.4
211	Potatoes, boiled, edible portion	27.50	12.47					
	Potatoes, edible portion			28.25	12.81	2.2	.1	18.4
212	Potatoes, boiled, edible portion	28.25	12.81					
	Potatoes, edible portion			28.00	12.70	2.2	.1	18.4
214	Potatoes, boiled and browned	19.50	8.85					
	Potatoes, edible portion			20.75	9.41	2.2	.1	18.4
215	Potatoes, boiled and browned	18.50	8.39					
	Potatoes, edible portion			25.50	11.57	2.2	.1	18.4
216	Potatoes, boiled and browned	22.00	9.98					
	Potatoes, as purchased			26.00	11.79	1.8	.1	14.7
218	Potatoes, browned	17.50	7.94					
	Potatoes, cooked, edible portion			6.10	2.77	1.9	.1	15.0
	Potatoes, edible portion			15.25	6.92	2.2	.1	18.4
	Butter			1.00	.45	1.0	85.0	
	Lard			.25	.11		100.0	
219	Potatoes, fried	17.75	8.05					
	Potatoes, cooked, edible portion			4.75	2.15	2.3	.1	19.8
	Potatoes, edible portion			15.50	7.03	2.2	.1	18.4
	Butter			1.25	.57	1.0	85.0	
220	Potatoes, fried	19.25	8.73					
	Potatoes, edible portion			22.40	10.16	2.2	.1	18.4
	Butter			2.50	1.13	1.0	85.0	
221	Potatoes, fried	15.00	6.80					
	Potatoes, edible portion			17.90	8.12	2.2	.1	18.4
	Butter			.75	.34	1.0	85.0	
	Lard			.75	.34		100.0	
223	Potatoes, hashed	15.50	7.03					
	Potatoes, cooked, edible portion			5.50	2.50	2.5		20.9
	Potatoes, cooked, edible portion			15.50	7.03	2.2		18.9
224	Potatoes, mashed and creamed	28.50	12.93					
	Potatoes, edible portion			23.00	10.43	2.2	.1	18.4
	Milk			5.00	2.27	3.3	4.0	5.0
	Butter			.50	.23	1.0	85.0	
225	Potatoes, mashed and creamed	29.50	13.38					
	Potatoes, edible portion			24.00	10.89	2.2	.1	18.4
	Milk			5.00	2.27	3.3	4.0	5.0
	Butter			.50	.23	1.0	85.0	
226	Potatoes, mashed and creamed	31.75	14.40					
	Potatoes, edible portion			25.75	11.68	2.2	.1	18.4
	Milk			6.25	2.84	3.3	4.0	5.0
	Butter			.75	.34	1.0	85.0	
227	Potatoes, mashed and creamed	26.25	11.91					
	Potatoes, edible portion			27.75	12.59	2.2	.1	18.4
	Milk			2.25	1.02	3.3	4.0	5.0
	Butter			1.25	.57	1.0	85.0	

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
228	Potatoes, creamed	26.75	12.13					
	Potatoes, cooked, edible portion			21.75	9.87	2.3	0.1	19.8
	Milk			4.15	1.88	3.3	4.0	5.0
	Butter			.75	.34	1.0	85.0	
	Flour			1.25	.57	11.4	1.0	75.1
231	Potato cakes, fried	20.00	9.07					
	Potatoes, edible portion			19.00	8.62	2.2	.1	18.4
	Butter			1.35	.61	1.0	85.0	
234	Rhubarb sauce	425.25	192.89					
	Rhubarb, canned (as fresh rhubarb)			346.00	156.95	.6	.7	3.6
	Sugar			89.25	40.48			100.0
237	Bean soup[a]	587.75	266.60					
	Beans, pea, white, dried			45.00	20.41	22.5	1.8	59.6
	Flour			17.50	7.94	11.4	1.0	75.1
238	Bean soup[a]	589.00	267.17					
	Beans, pea, white, dried			49.75	22.57	22.5	1.8	59.6
	Flour			11.25	5.10	11.4	1.0	75.1
	Onions			1.50	.68	1.6	.3	9.9
240	Corn soup, clear[a]	92.50	41.96					
	Corn, canned[b]							
	Meat (soup stock)[a]							
	Milk			29.75	13.19	3.3	4.0	5.0
	Butter			1.00	.45	1.0	85.0	
	Flour			1.50	.68	11.4	1.0	75.1
242	Potato soup[a]	96.00	43.55					
	Onions			2.00	.91	1.6	.3	9.9
	Celery			.75	.34	1.1	.1	3.3
	Potatoes			10.75	4.88	2.2	.1	18.4
	Milk			29.50	13.38	3.3	4.0	5.0
	Flour			1.25	.57	11.4	1.0	75.1
	Butter			1.00	.45	1.0	85.0	
243	Tomato soup[a]	95.00	43.09					
	Tomatoes, canned[b]			36.25	16.44			
	Rice			2.50	1.13	8.0	.3	79.0
	Onions, edible portion			1.75	.79	1.6	.3	9.9
	Flour			.50	.23	11.4	1.0	75.1
	Butter			.50	.23	1.0	85.0	
	Sugar			1.50	.68			100.0
244	Tomato soup[a]	94.00	42.64					
	Tomatoes, canned[b]			37.00	16.78			
	Rice			3.00	1.36	8.0	.3	79.0
	Sugar			2.75	1.25			100.0
	Butter			.50	.23	1.0	85.0	
246	Vegetable soup[a]	85.75	38.90					
	Rice			2.00	.91	8.0	.3	79.0
	Peas, canned			2.75	1.25	3.6	.2	9.8
	Corn, canned			2.60	1.18	2.8	1.2	19.0
	Tomatoes, canned			12.50	5.67	1.2	.2	4.0
	Onions			1.50	.68	1.6	.3	9.9
	Carrots			1.50	.68	1.1	.4	9.3
	Celery			.40	.18	1.1	.1	3.3
	Cabbage			.50	.23	1.6	.3	5.6
	Flour			.60	.27	11.4	1.0	75.1
247	Vegetable soup[a]	94.50	42.87					
	Rice			2.50	1.13	8.0	.3	79.0
	Tomatoes, canned			12.50	5.67	1.2	.2	9.0
	Corn, canned			2.50	1.13	2.8	1.2	19.0
	Peas, canned			1.25	.57	3.6	.2	9.8
	Onions, potatoes, carrots, and cabbage (mixed lot)			3.50	1.59	1.6	.3	10.8
	Flour			.60	.27	11.4	1.0	75.1
248	Vegetable soup[a]	42.50	19.28					
	Onions			1.50	.68	1.6	.3	9.9
	Carrots			.50	.23	.9	.2	7.4
	Tomatoes, canned			9.25	4.20	1.2	.2	4.0
	Rice			.25	.11	8.0	.3	79.0
	Corn, canned			4.75	2.15	2.8	1.2	19.0
	Potatoes			2.35	1.07	2.2	.1	18.4
	Cabbage			1.15	.52	1.6	.3	5.6
249	Vegetable soup[a]	40.50	18.37					
	Rice			.50	.23	8.0	.3	79.0
	Flour			1.25	.57	11.4	1.0	75.1

[a] Stock was used in making soup in almost every instance, but the quantity of nutrients in it could not be estimated, hence it is generally not mentioned.

[b] These articles were cooked in the soup for some time and then strained out. Whatever nutritive material may have cooked out of them was necessarily neglected in computing the composition of the soup.

Table 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
249	Vegetable soup—Continued.							
	Tomatoes, canned			8.75	3.97	1.2	0.2	4.0
	Onions			2.50	1.13	1.4	.3	8.9
	Carrots			1.00	.45	.9	.2	7.4
	Corn, canned			3.70	1.68	2.8	1.2	19.0
	Cabbage			1.75	.79	1.6	.3	5.6
	Potatoes			2.00	.91	2.2	.1	18.4
250	Vegetable soup[a]	541.00	245.40					
	Potatoes			17.50	7.94	2.2	.1	18.4
	Carrots			1.75	.79	1.1	.4	9.3
	Onions			2.00	.91	1.6	.3	9.9
	Rice			15.00	6.80	8.0	.3	79.0
	Tomatoes, canned			13.75	6.24	1.2	.2	4.0
	Flour			14.50	6.58	11.4	1.0	75.1
251	Vegetable soup[a]	564.25	255.94					
	Tomatoes, canned			12.50	5.67	1.2	.2	4.0
	Carrots			2.25	1.02	1.1	.4	9.3
	Onions			.25	.11	1.6	.3	9.9
	Potatoes			14.25	6.46	2.2	.1	18.4
	Rice			12.00	5.44	8.0	.3	79.0
	Cabbage			7.50	3.40	1.6	.3	5.6
	Flour			12.25	5.56	11.4	1.0	75.1
254	Squash, boiled	69.50	31.53					
	Squash			94.00	42.64	1.4	.5	9.0
255	Succotash	530.00	240.41					
	Beans, lima, dried			85.00	38.56	18.1	1.5	65.9
	Corn, canned			240.00	108.86	2.8	1.2	19.0
	Butter			8.00	3.63	1.0	85.0	
	Flour			3.00	1.36	11.4	1.0	75.1
257	Sweet potatoes, baked, edible portion	34.00	15.42					
	Sweet potatoes, edible portion			42.75	19.39	1.8	.7	27.4
	Butter			2.00	.91	1.0	85.0	
	Sugar			.50	.23			100.0
259	Sweet potatoes, boiled and browned	17.00	7.71					
	Sweet potatoes			21.75	9.87	1.8	.7	27.4
	Butter			1.00	.45	1.0	85.0	
260	Sweet potatoes, boiled and browned	18.50	8.39					
	Sweet potatoes, edible portion			19.50	8.85	1.8	.7	27.4
	Sugar			1.00	.45			100.0
	Butter			.40	.18	1.0	85.0	
262	Sweet potato roll	22.25	10.09					
	Sweet potatoes, edible portion			21.50	9.75	1.8	.7	27.4
	Butter			1.00	.45	1.0	85.0	
	Sugar			.50	.23			100.0
263	Tomato sauce (stewed plum tomatoes)	140.25	63.62					
	Plum tomatoes, as purchased			111.75	50.69	.9	.4	3.9
	Sugar			17.00	7.71			100.0
	Flour			13.00	5.90	11.4	1.0	75.1
264	Tomato sauce (stewed plum tomatoes)	59.25	26.88					
	Plum tomatoes, as purchased			43.75	19.85	.9	.4	3.9
	Sugar			11.00	4.99			100.0
	Flour			5.75	2.61	11.4	1.0	75.1
266	Tomatoes, stewed	18.50	8.39					
	Tomatoes, canned			18.75	8.51	1.2	.2	4.0
	Butter			.25	.11	1.0	85.0	
	Sugar			1.50	.68			100.0
	Bread			1.00	.45	9.2	1.3	53.1
267	Tomatoes, stewed	20.75	9.41					
	Tomatoes, canned			20.10	9.12	1.2	.2	4.0
	Bread			1.50	.68	9.2	1.3	53.1
	Sugar			.50	.23			100.0
	Butter			.35	.16	1.0	85.0	
269	Turnips, boiled, edible portion	285.00	129.28					
	Turnips, edible portion			320.00	145.15	1.3	.2	8.1
272	Apples, baked, edible portion	21.75	9.87					
	Apples, edible portion			21.00	9.53	.4	.5	14.2
	Sugar			2.00	.91			100.0
273	Apples, baked, as purchased	215.00	97.52					
	Apples, as purchased			238.00	107.96	.3	.3	10.8
	Sugar			10.75	4.88			100.0
274	Apples, baked, as purchased	221.00	100.25					
	Apples, as purchased			241.50	109.55	.3	.3	10.8
	Sugar			7.00	3.18			100.0
277	Apples, fried	11.90	5.40					
	Apples, edible portion			8.25	3.74	.4	.5	14.2
	Eggs, as purchased			1.50	.68	13.1	9.3	
	Flour			2.50	1.13	11.4	1.0	75.1

[a] Stock was used in makink soup in almost every instance, but the quantity of nutrients in it could not be estimated, hence it is generally not mentioned.

Table 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
		Lbs.	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
283	Pears, stewed, edible portion	27.00	12.25					
	Pears, edible portion			19.00	8.62	0.6	0.5	14.1
	Sugar			3.00	1.36			100.0
284	Pears, stewed, edible portion	26.25	11.91					
	Pears, edible portion			17.00	7.71	.6	.5	14.0
	Sugar			4.25	1.93			100.1
286	Prunes, stewed, as purchased	21.25	9.64					
	Prunes, dried			8.50	3.86	1.8		62.2
	Sugar			3.50	1.59			100.0
287	Prunes, stewed, as purchased	123.25	55.91					
	Prunes, dried			50.50	22.91	1.8		62.2
	Sugar			14.25	6.46			100.0
288	Prunes, stewed, as purchased	109.75	49.78					
	Prunes, dried			51.00	23.13	1.8		62.2
	Sugar			15.50	7.03			100.0
289	Prunes, stewed, as purchased	96.75	43.89					
	Prunes, dried			47.75	21.66	1.8		62.2
	Sugar			11.25	5.10			100.0
290	Prunes, stewed, as purchased	502.00	227.71					
	Prunes, dried			200.00	90.72	1.8		62.2
	Sugar			48.00	21.77			100.0
294	Apple sauce	19.00	8.62					
	Apples, as purchased			13.50	6.12	.3	.3	10.8
	Sugar			3.75	1.70			100.0
295	Apple sauce	21.50	9.75					
	Apples, edible portion			19.50	8.85	.4	.5	14.2
	Lemons, as purchased			.50	.23	.7	.5	5.9
	Sugar			3.00	1.36			100.0
296	Apple sauce	18.50	8.39					
	Apples, edible portion			11.00	4.99	.4	.5	14.2
	Sugar			2.00	.91			100.0
297	Apple sauce	25.50	11.57					
	Apples, edible portion			22.00	9.98	.4	.5	14.2
	Sugar			6.00	2.72			100.0
298	Apple sauce	17.00	7.71					
	Apples, edible portion			12.50	5.67	.4	.5	14.2
	Sugar			4.00	1.81			100.0
299	Apple sauce	32.75	14.86					
	Apples, edible portion			17.50	7.94	.4	.5	14.2
	Sugar			4.75	2.15			100.0
	Apple sauce (from another lot)			10.50	4.76	.4	.4	
300	Apple sauce (from evaporated apples)	433.00	196.41					
	Apples, evaporated			100.00	45.36	1.6	2.2	66.1
	Sugar			65.00	29.48			100.0
303	Cranberry sauce	23.25	10.55					
	Cranberries, as purchased			13.50	6.12	.4	.6	9.9
	Sugar			5.75	2.61			100.0
304	Peach sauce (from evaporated peaches)	103.75	47.06					
	Peaches, evaporated			50.00	22.68	4.7	1.0	62.5
	Sugar			7.50	3.40			100.0
305	Peach sauce (from evaporated peaches)	32.50	14.74					
	Peaches, evaporated			10.00	4.54	4.7	1.0	62.5
	Sugar			2.25	1.02			100.0
306	Peach sauce (from evaporated peaches)	452.00	205.03					
	Peaches, evaporated			150.00	68.04	4.7	1.0	62.5
	Sugar			60.00	27.22			100.0
308	Hash	56.00	25.40					
	Beef, boiled, as purchased (as boiled beef, canned)			25.00	11.34	25.5	22.5	
	Onions			1.50	.68	1.6	.3	9.9
	Potatoes, boiled			26.75	12.13	2.5	.1	20.9
309	Hash, baked	132.00	59.88					
	Beef, boiled, edible portion			48.00	22.77	29.3	33.1	
	Potatoes, steamed			56.00	25.40	2.4		20.1
	Onions, tops			3.50	1.59	1.0	.1	11.2
	Fat gravy			21.00	9.53		75.0	
	Bread crumbs (as bread)			2.00	.91	9.2	1.3	53.1
310	Liver and bacon, fried	10.00	4.54					
	Liver			5.50	2.50	20.7	4.5	1.5
	Bacon, fat, edible portion			14.50	6.58	9.9	67.4	
	Fat cooked out			6.00	2.72		100.0	
311	Meat pie	49.50	22.45					
	Stew beef and pork, chopped							
	Average of beef and pork side			21.00	9.53	13.6	38.7	

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
311	Meat pie—Continued.	*Lbs.*	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
	Potatoes, edible portion			15.00	6.80	2.2	0.1	18.4
	Flour			7.25	3.29	11.4	1.0	75.1
	Lard			2.50	1.13		100.0	
312	Beef stew	42.50	19.28					
	Beef, side, edible portion			21.25	9.64	18.1	22.0	
	Potatoes, edible portion			11.50	5.22	2.2	.1	18.4
	Flour			2.00	.91	11.4	1.0	75.1
313	Beef, stew	218.00	98.89					
	Beef (average of several computations)			61.00	27.67	28.5	30.5	
	Beef, lean (as round), edible portion			6.50	2.95	22.6	2.8	
	Potatoes, boiled, as purchased			13.75	6.24	2.5	.1	20.9
	Flour			12.50	5.67	11.4	1.0	75.1
	Onions			2.50	1.13	1.6	.3	9.9
	Potatoes			27.25	12.36	2.2	.1	18.4
314	Beef, stew	207.50	94.12					
	Beef, boiled, edible portion (as No. 5)			57.50	26.08	30.5	30.6	
	Flour			14.75	6.69	11.4	1.0	75.1
	Potatoes			30.00	13.61	2.2	.1	18.4
	Onions			2.75	1.25	1.6	.3	9.9
315	Beef, stew	226.50	102.74					
	Beef, boiled, edible portion (as No. 5)			29.25	13.27	30.5	30.6	
	Potatoes, edible portion			31.00	14.06	2.2	.1	18.4
	Beef, boiled, edible portion			35.50	16.10	31.8	28.3	
	Onions, edible portion			2.00	.91	1.6	.3	9.9
	Flour			16.50	7.49	11.4	1.0	75.1
317	Mutton, stew	49.00	22.23					
	Mutton, neck, as purchased			28.75	13.04	12.3	17.9	
	Potatoes			17.25	7.82	2.2	.1	18.4
	Flour			1.25	.57	11.4	1.0	75.1
	Fat cooked out			1.50	.68		100.0	
319	Chicken, creamed	25.75	11.68					
	Chicken, fricasseed			8.00	3.63	17.6	11.5	2.4
	Milk			12.00	5.44	3.3	4.0	5.0
	Butter			.25	.11	1.0	85.0	
321	Oysters, creamed	19.75	8.96					
	Oysters, solids			9.50	4.31	6.0	1.3	3.3
	Milk			7.50	3.40	3.3	4.0	5.0
	Butter			1.00	.45	1.0	85.0	
	Flour			.75	.34	11.4	1.0	75.1
323	Oyster stew	41.75	20.30					
	Oysters, solids			15.00	6.80	6.0	1.3	3.3
	Milk			26.25	11.91	3.3	4.0	5.0
	Butter			.50	.23	1.0	85.0	
326	Oyster soup	92.50	41.96					
	Oysters, solids			12.75	5.78	6.0	1.3	3.3
	Flour			1.10	.50	11.4	1.0	75.1
	Milk			41.75	18.94	3.3	4.0	5.0
	Butter			.50	.23	1.0	85.0	
328	Sauce, for halibut	10.00	4.53					
	Eggs, as purchased			2.00	.91	13.1	9.3	
	Milk			3.00	1.36	3.3	4.0	5.0
	Flour			.50	.23	11.4	1.0	75.1
	Butter			.75	.34	1.0	85.0	
329	Gravy	7.25	3.29					
	Juice and fat from fried steak[a]							
	Butter			.75	.34	1.0	85.0	
	Flour			.50	.23	11.4	1.0	75.1
330	Onion sauce (for steak)	8.75	3.97					
	Onions			1.15	.52	1.6	.3	9.9
	Juice and fat from steak[a]							
331	Griddle cakes	2.15	.98					
	Milk			1.00	.45	3.3	4.0	5.0
	Flour			1.00	.45	11.4	1.0	75.1
	Rice, boiled			.15	.07	1.2		12.1
333	Macaroni and cheese, baked	20.00	9.07					
	Cheese			2.75	1.25	25.9	33.7	2.4
	Macaroni			3.25	1.47	13.4	.9	74.1
	Milk			7.50	3.40	3.3	4.0	5.0
	Flour			.60	.27	11.4	1.0	75.1
334	Macaroni and tomatoes	59.25	26.88					
	Macaroni			12.00	5.44	13.4	.9	74.1
	Tomatoes, canned			19.15	8.69	1.2	.2	4.0

[a] The nutrients in these materials could not be calculated.

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
334	Macaroni and tomatoes—Continued.	*Lbs.*	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
	Flour			2.25	1.02	11.4	1.0	75.1
	Butter			.25	.11	1.0	85.0	
335	Muffins	12.25	5.56					
	Butter			.75	.34	1.0	85.0	
	Lard			.75	.34		100.0	
	Eggs, edible portion			2.50	1.13	14.8	10.5	
	Flour			6.00	2.72	11.4	1.0	75.1
	Milk			5.00	2.27	3.3	4.0	5.0
336	Custard, plain, baked	18.00	8.17					
	Sugar			2.25	1.02			100.0
	Eggs, edible portion			3.25	1.47	14.8	10.5	
	Milk			14.25	6.46	3.3	4.0	5.0
337	Custard, chocolate	28.75	13.04					
	Milk			22.00	9.98	3.3	4.0	5.0
	Chocolate			1.00	.45	12.9	48.7	30.3
	Eggs (whites only)			3.60	1.63	13.0	.2	
	Sugar			3.25	1.47			100.0
338	Custard sauce for jelly	10.75	4.88					
	Milk			4.25	1.93	3.3	4.0	5.0
	Sugar			1.50	.68			100.0
	Eggs, as purchased			3.00	1.36	13.1	9.3	
340	Caramel ice cream	34.50	15.65					
	Sugar			6.00	2.72			100.0
	Milk			25.50	11.57	3.3	4.0	5.0
	Eggs, as purchased			3.75	1.70	13.1	9.3	
341	Lemon ice	12.25	5.56					
	Lemon juice			1.50	.68			9.8
	Sugar			10.00	4.54			100.0
	Eggs (whites)			.75	.34	13.0	.2	
342	Lemon jelly	29.00	13.15					
	Gelatin			1.00	.45	91.4	.1	
	Lemon juice			1.00	.45			9.8
	Sugar			4.50	2.04			100.0
	Wine, sherry [a]			1.50	.68			34.0
344	Apple pie	25.50	11.57					
	Apples, edible portion			19.00	8.62	.4	.5	14.2
	Flour			3.75	1.70	11.4	1.0	75.1
	Lard			1.60	.73		100.0	
	Sugar			1.90	.86			100.0
350	Rhubarb pie	269.50	122.25					
	Rhubarb, canned			103.00	46.72	.6	.7	3.6
	Sugar			24.00	10.89			100.0
	Flour			60.00	27.22	11.4	1.0	75.1
	Lard			30.00	13.61		100.0	
353	Pudding, bread	228.50	103.65					
	Currants, dried			4.75	2.15	2.4	1.7	74.2
	Raisins, as purchased			1.50	.68	2.3	3.0	68.5
	Sugar			20.50	9.30			100.0
	Eggs, as purchased			6.00	2.72	13.1	9.3	
	Cream, evaporated			7.50	3.40	9.6	9.3	11.2
	Butter			3.88	1.76	1.0	85.0	
	Bread			46.50	21.09	9.2	1.3	53.1
354	Pudding, chocolate	25.50	11.57					
	Milk			21.75	9.87	3.3	4.0	5.0
	Chocolate			.75	.34	12.9	48.7	30.3
	Sugar			2.75	1.25			100.0
	Cornstarch			1.50	.68			90.0
355	Pudding, chocolate	24.35	11.05					
	Milk			23.25	10.55	3.3	4.0	5.0
	Sugar			3.25	1.47			100.0
	Chocolate			1.00	.45	12.9	48.7	30.3
	Cornstarch			1.35	.61			90.0
359	Pudding, cottage	13.50	6.12					
	Butter			1.35	.61	1.0	85.0	
	Sugar			4.25	1.93			100.0
	Milk			2.75	1.25	3.3	4.0	5.0
	Eggs, as purchased			1.95	.89	13.1	9.3	
	Flour			5.00	2.27	11.4	1.0	75.1
360	Pudding, floating island	25.00	11.34					
	Milk			20.00	9.07	3.3	4.0	5.0
	Eggs, as purchased			3.75	1.70	13.1	9.3	
	Cornstarch			.50	.23			90.0
	Sugar			2.50	1.13			100.0
361	Pudding, floating island	29.50	13.38					
	Sugar			3.25	1.47			100.0
	Milk			22.75	10.32	3.3	4.0	5.0

[a] Percentage composition estimated.

TABLE 38.—*Data for computing percentage composition of cooked foods used in the dietary studies*—Continued.

Reference No.	Kinds of cooked food and of ingredients.	Total weight of cooked food.		Weight of ingredients.		Percentage composition of ingredients.		
						Protein.	Fat.	Carbohydrates.
361	Pudding, floating island—Continued.	*Lbs.*	*Kilos.*	*Lbs.*	*Kilos.*	*Per ct.*	*Per ct.*	*Per ct.*
	Eggs, edible portion			3.50	1.59	14.8	10.5	
	Cornstarch			1.45	.66			90.0
	Flour			1.25	.57	11.4	1.0	75.1
363	Pudding, junket	33.75	15.31					
	Junket tablets[a]							
	Milk			24.00	10.89	3.3	4.0	5.0
	Sugar			1.25	.57			100.0
	Cherries, preserved			1.50	.68	1.0		60.0
	Oranges, edible portion			7.00	3.18	.8	.2	11.6
364	Pudding, rice	29.50	13.38					
	Milk			16.75	7.60	3.3	4.0	5.0
	Eggs, as purchased			3.25	1.47	13.1	9.3	
	Rice, boiled			11.00	4.99	1.3		13.0
	Lemon juice							9.8
	Sugar			2.50	1.13			100.0
365	Pudding, rice	130.75	59.31					
	Rice			10.00	4.54	8.0	.3	79.0
	Eggs, as purchased			14.25	6.46	13.1	9.3	
	Sugar			13.75	6.24			100.0
	Milk			53.50	24.27	3.3	4.0	5.0
	Milk, condensed			9.75	4.42	8.8	8.3	54.1
366	Pudding, steamed	110.00	49.90					
	Cream, evaporated			5.75	2.61	9.6	9.3	11.2
	Flour			24.25	11.00	11.4	1.0	75.1
	Suet			10.25	4.65	4.7	81.8	
	Currants, dried			21.25	9.64	2.4	1.7	74.2
	Bread			10.00	4.54	9.2	1.3	53.1
	Raisins, edible portion			5.00	2.27	2.6	3.3	76.1
	Molasses			8.75	3.97			70.0
	Sugar			9.75	4.42			100.0
367	Pudding, fruit, steamed	318.50	144.47					
	Bread, dry			39.00	17.69	11.5	1.6	61.2
	Currants, dry			50.00	22.68	2.4	1.7	74.2
	Molasses			69.00	31.30			70.0
	Raisins, edible portion			28.50	12.93	2.6	3.3	76.1
	Sugar			10.00	4.54			100.0
	Suet			15.75	7.14	4.7	81.8	
	Milk			48.00	21.77	3.3	4.0	5.0
	Flour			44.50	20.19	11.4	1.0	75.1
369	Lemon sauce (for pudding)	11.50	5.22					
	Eggs, edible portion			1.50	.68	14.8	10.5	
	Lemons, as purchased			3.00	1.36	.7	.5	5.9
	Sugar			2.00	.91			100.0
370	Sauce, for pudding	10.75	4.88					
	Butter			.45	.20	1.0	85.0	
	Eggs, as purchased			1.00	.45	13.1	9.3	
	Sugar			1.50	.68			100.0
371	Sauce, for pudding	8.00	3.63					
	Milk			6.00	2.72	3.3	4.0	5.0
	Eggs, edible portion			1.25	.57	14.8	10.5	
	Sugar			1.00	.45			100.0

[a] The nutrients in these materials could not be calculated.

LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON THE FOOD AND NUTRITION OF MAN—Continued.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 151.

A. C. TRUE, Director.

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OF THE

AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS

IN THE

UNITED STATES.

DECEMBER, 1904.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 151.

A. C. TRUE, Director.

ORGANIZATION LISTS

OF THE

AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS

IN THE

UNITED STATES.

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WASHINGTON:
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1904.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., December 1, 1904.

Sir: I have the honor to transmit herewith manuscript of a bulletin containing the organization lists of agricultural colleges and experiment stations in the United States. The matter has been compiled under my direction by Mr. D. J. Crosby and Miss M. T. Spethmann of this Office, and I recommend its publication as Bulletin No. 151.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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KEY TO ABBREVIATIONS.

NOTE.—Members of boards of trustees or other governing boards of the college who are charged with the management of experiment station affairs are indicated by an asterisk (*).

Acct., Accountant.
Actg., Acting.
(*Actg.*) Acting Professor.
(*Adjunct*), Adjunct Professor.
Agr., Agriculture, Agriculturist, Agricultural.
Agron., Agronomy, Agronomist.
Agt., Agent.
Anal., Analytical, Analysis.
Anat., Anatomy.
Arbor., Arboriculture, Arboriculturist.
Archi., Architecture.
Arith., Arithmetic.
Assoc., Associate.
(*Assoc.*), Associate Professor.
Asst., Assistant.
(*Asst.*), Assistant Professor.
Astron., Astronomy.
Bact., Bacteriology, Bacteriologist.
Bibliog., Bibliography, Bibliographer.
Biol., Biology, Biologist, Biological.
Blacksm., Blacksmithing.
Bot., Botany, Botanist, Botanical.
Chair., Chairman.
Chem., Chemist, Chemistry, Chemical.
Climat., Climatology, Climatologist.
Comdt., Commandant.
Com'l, Commercial.
Comr., Commissioner.
Corresp., Correspondence, Correspondent.
Dept., Department.
Dir., Director.
Div., Division.
Dom., Domestic.
Draw., Drawing.
Econ., Economy, Economic, Economics.
Ed., Education.
El., Elementary.
Elect., Electrical, Electricity.
Engin., Engineer, Engineering.
Engl., English.
Ent., Entomology, Entomologist.
Expt., Experiment, Experimental, Experimentalist, Experimenter.
Ext., Extension.
Flor., Floriculture, Florist.
For., Forestry.
Gard., Gardener, Gardening.
Gen., General.
Geog., Geography.
Geol., Geology, Geologist, Geological.
Gov., Governor.
Hist., History, Historical.
Hort., Horticulture, Horticulturist.
Husb., Husbandry, Husbandman.
Indus., Industrial, Industries, Industry.
Inst., Institutes.
Instr., Instruction, Instructor.
Invest., Investigations.
Irrig., Irrigation.
Lab., Laboratory.
Lang., Language, Languages.
Lat., Latin.
Lect., Lecturer.
Libr., Library, Librarian.
Lit., Literature.
Mach., Machinery, Machinist.
Math., Mathematics.
Mech., Mechanics, Mechanician, Mechanical.
Met., Meteorology, Meteorologist.
Metal., Metallurgy.
Mfg., Manufacturing.
Mgr., Manager.
Mil., Military.
Min., Mineralogy, Mineralogist, Mining.
Mod., Modern.

Myc., Mycology, Mycologist.
Nat., Natural.
Org., Organic.
Paint., Painting.
Path., Pathology, Pathologist.
Pedag., Pedagogy, Pedagogics.
Pharm., Pharmacy, Pharmacist.
Philos., Philosophy.
Photog., Photography.
Phys., Physics, Physicist, Physical.
Physiol., Physiology, Physiologist, Physiological.
Polit., Political.
Pomol., Pomology, Pomologist.
Pract., Practice, Practical.
Prep., Preparatory.
Pres., President.
Prin., Principal.
Print., Printing.
Psych., Psychology.
Rhet., Rhetoric.
Sci., Science, Scientific.
Sec., Secretary.
Sew., Sewing.
Sociol., Sociology.
Sta., Station.
Sten., Stenography, Stenographer.
Substa., Substation.
Supt., Superintendent.
Tech., Technology, Technical.
Teleg., Telegraphy.
Treas., Treasurer.
Typew., Typewriting, Typewriter.
Univ., University.
V. Dir., Vice-Director.
Veg., Vegetable, Vegetation.
Vet., Veterinary, Veterinarian.
Vit., Viticulture, Viticulturist.
V. Pres., Vice-President.
Wheelwr., Wheelwrighting.
Zool., Zoology, Zoologist.

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COURSES OF STUDY.

The courses of study are ten. Seven of these require four years for completion, and lead to the degree of B. S.: Course in chemistry and agriculture; course in civil engineering; course in electrical, mechanical, and mining engineering; course in pharmacy; general course; course in chemistry and metallurgy. The remaining courses require two years each and lead to a certificate: Course in agriculture, course in mechanic arts, and course in pharmacy.

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[a] On leave.

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Agrcultural Experiment Station of the Alabama Polytechnic Institute, *Auburn.*

Department of the Alabama Polytechnic Institute, under the control of the Board of Trustees.

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Agricultural and Mechanical College for Negroes, *Normal.*

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COURSES OF STUDY.

The college is divided into two departments—literary and industrial. The courses requiring four years for completion are as follows: Scientific, agricultural, and mechanical. Courses covering from one to four years are given in a number of different industrial and literary subjects.

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[a] On leave.

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Agricultural School of the Tuskegee Normal and Industrial Institute, *Tuskegee Institute.*

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The institute is divided into five departments: Academic, music, Bible training school, mechanical industries, and agriculture.

The school of agriculture offers two two-year courses in agriculture—one to young men and one to young women.

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Tuskegee Agricultural Experiment Station, *Tuskegee Institute.*

Department of the Tuskegee Normal and Industrial Institute, under the control of the Board of Trustees of the Institute.

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Alaska Agricultural Experiment Stations, *Sitka, Kenai, Copper Center, and Rampart.*

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The university offers six regular four-year courses of study leading to a degree, viz, literary, scientific, engineering, chemistry, mining, and agriculture; also a short course in mineralogy and assaying.

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[a] On leave.

Agricultural Experiment Station of University of Arizona, *Tucson*.

Department of the University of Arizona, under the control of the Board of Regents.

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Arkansas Agricultural Experiment Station, *Fayetteville.*

Department of the University of Arkansas, under the control of the Board of Trustees.

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COURSES OF STUDY.

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Agricultural Experiment Station of the University of California, *Berkeley.*

Department of the University of California, under the control of the Regents of the University.

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E. J. Wickson, M. A., *Hort.*
W. A. Setchell, Ph. D., *Bot.*
R. H. Loughridge, Ph. D., *Agr. Geol. and Soil Phys.* (*Soils and Alkali*).
C. W. Woodworth, M. S., *Ent.*
Ralph E. Smith, B. S., *Plant Path.*
Elwood Mead, C. E., D. E., *Irrig. Engin.*
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[a] Includes only instructors in subjects *directly relating to agriculture.* Other members of the university faculty may give instruction to students pursuing the agricultural course.

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COURSES OF STUDY.

The courses of study are eight, each requiring four years in addition to two years of preparatory work, and each leading to the degree of B. S.: The agricultural course, the mechanical engineering course, the irrigation and civil engineering course, the domestic science course, the architectural course, the veterinary science course, the electrical engineering course, and the horticultural course. Provision is made for postgraduate work. The degrees of M. S., C. E., and M. E. are conferred upon those worthy of holding them by faculty action approved by the governing board. A commercial course and a normal course in domestic science, each covering a period of two years, are established, entrance to which requires the same qualifications as for admission to the freshman class; no degree is given.

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The regular courses of study are nine, each requiring four years for completion, except the sugar course, which requires five years: The course in agriculture, the course in sugar cultivation and manufacture, the course in civil engineering, electrical engineering, the course in mechanics, the general science course, the commercial course, the Latin science course, and the literary course, the first six leading to the degree of B. S., the others to the degree of B. A. A preparatory department, with a course covering one year, and a two-year course in agriculture, are also provided.

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B. S.; the technical courses lead to the degree of B. S. Two-year course in pharmacy leads to the degree of Ph. C. Other short courses are school course in agriculture of two years; winter courses in agriculture, dairying, and horticulture of eight weeks, followed by three weeks' course in horticulture and poultry management. The course in the School of Laws is three years and leads to degree of LL. B.

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In the School of Agriculture the four-year course leads to the degree of B. S. in Agr. There are also three short courses of two months in plant production, animal husbandry, and dairying. In the School of Engineering, four-year courses lead to the degrees of B. S. in civil engineering, in electrical engineering, in mechanical engineering, in sanitary engineering, and in chemical engineering, respectively. The degrees of C. E., E. E., and M. E. are also given for graduate work.

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[a] On leave.

Missouri Agricultural College Experiment Station, *Columbia.*

Department of the College of Agriculture and Mechanic Arts of the University of Missouri, under the control of the Board of Curators.

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[a] On leave.

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Department of the Montana College of Agriculture and Mechanic Arts, under the control of the Executive Board.

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J. S. Baker, B. S., *Irrig. Engin.*
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[a] Includes only instructors in subjects directly relating to agriculture. Many other members of the university faculty give instruction to students pursuing the course leading to the degree of B. Sc.

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Agricultural Experiment Station of Nebraska, *Lincoln.*

Department of the University of Nebraska, under the control of the Board of Regents.

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A. T. Peters, D. V. M., *Animal Path.*
G. D. Swezey, M. A., *Met.*
O. V. P. Stout, C. E., *Irrig. Engin.*
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The regular course requires four years for completion and leads to the degree of B. S. Short courses in agriculture, dairying, domestic science, and assaying are given during the months of January, February, and March of each year, for the benefit of ranchers and prospectors.

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[a] On leave.

Nevada Agricultural Experiment Station, *Reno.*

Department of Nevada State University, under the control of the Board of Regents.

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Nathaniel E. Wilson, M. S., *V. Dir.; Chem.*
Peter Fransden, M. A., *Zool., Bact.*
P. B. Kennedy, Ph. D., *Bot., Hort.*
G. H. True, B. S., *Agr., Animal Husb.*
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There are five courses of study, each requiring four years for completion and leading to the degree of B. S.: Course in agriculture, course in chemistry, course in mechanical engineering, course in electrical engineering, and general course (open to women). Also a two-year course in agriculture not leading to any collegiate degree, a ten-week course in agriculture, and a ten-week course in dairying.

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COURSES OF STUDY.

There are six distinct courses of study: A course in agriculture, a course in civil engineering and mechanics, a course in chemistry, a course in electricity, a course in biology, and a course in clay working and ceramics. Each course requires four years for completion and leads to the degree of B. S. There is also a Latin scientific course which leads to the degree of B. Litt.

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[a] Includes only instructors in subjects directly relating to agriculture. Many other members of the university faculty give instruction to students pursuing the course leading to the degree of B. S. A.

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[a] Freight.

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Three-year courses are offered in agriculture, domestic science, and commerce, each leading to a certificate of graduation; four-year courses are offered in agriculture, domestic science, commerce, civil engineering, mechanical engineering, and general science, each leading to a degree. In addition, there are manual-training courses in domestic arts and mechanic arts, four years, each leading to a certificate of graduation; a college preparatory course, two years, and a sub-preparatory course, one year; also winter courses in agriculture, domestic arts, and mechanic arts.

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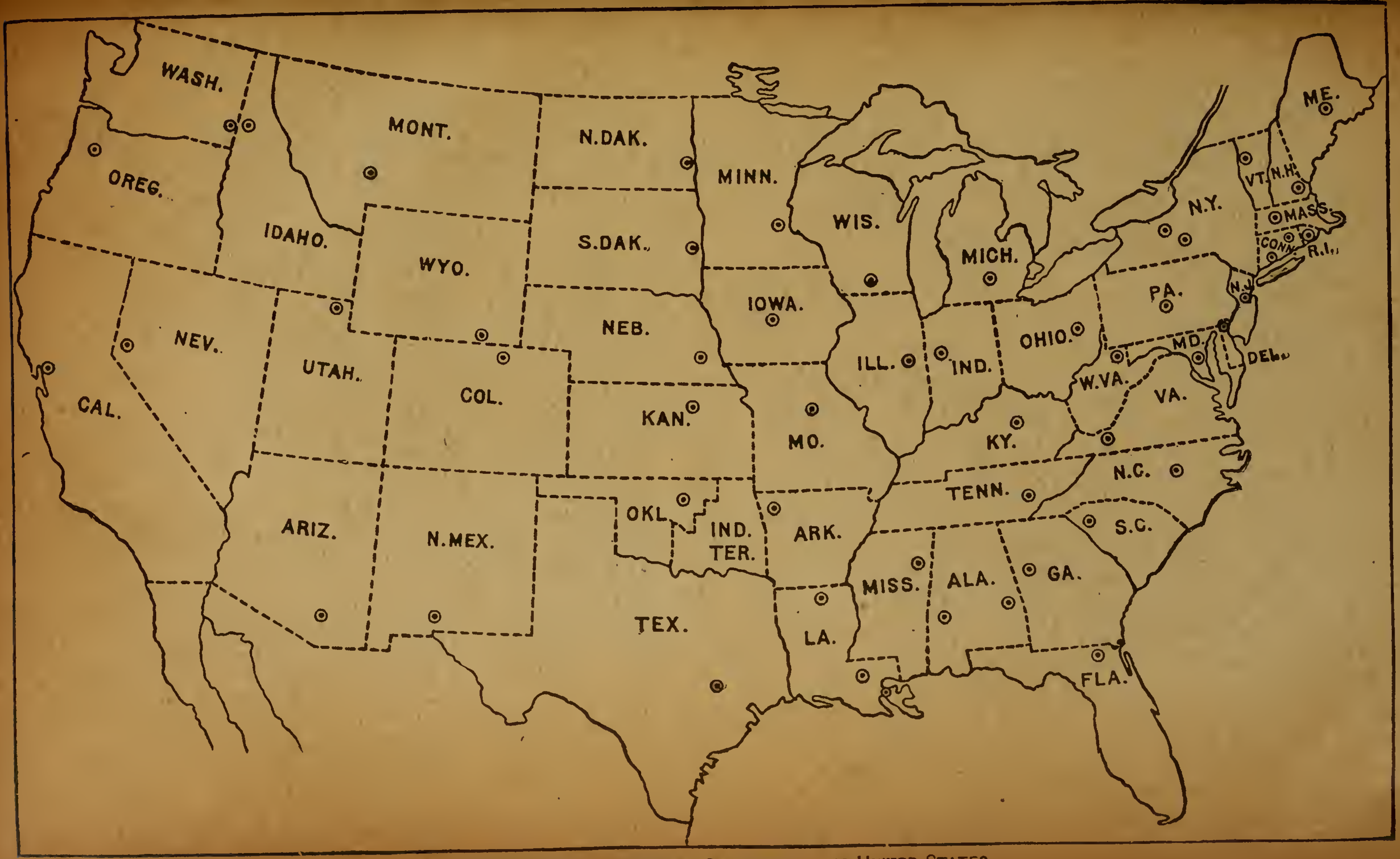

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 152.

A. C. TRUE, Director.

DIETARY STUDIES WITH HARVARD UNIVERSITY STUDENTS.

BY

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NEW YORK
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EDWARD MALLINCKRODT, JR.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

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[Continued on third page of cover.]

U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 152.

A. C. TRUE, Director.

DIETARY STUDIES WITH HARVARD UNIVERSITY STUDENTS.

BY

EDWARD MALLINCKRODT, JR.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., January 20, 1905.

Sir: I have the honor to transmit herewith a report of dietary studies with Harvard students carried on by Edward Mallinckrodt, jr. The desirability of such an investigation was suggested by Prof. F. G. Peabody, D. D., of Harvard University, and the work was carried out under the general direction of Prof. C. R. Sanger, a thesis based on the results being presented to the University by Mr. Mallinckrodt for the master's degree. The dietary studies were conducted in accordance with the methods devised in connection with the nutrition investigations carried on under the auspices of this Office, of which Prof. W. O. Atwater is in charge, and throughout the investigation Mr. Mallinckrodt was in consultation with Professor Atwater. Acknowledgment should be made to Dr. E. A. Darling and Dr. D. A. Sargent, of Harvard University, for cooperation in determining the physical condition and strength of the subjects. The results obtained are of especial value in their bearing upon dietary standards, particularly those of students and others of sedentary occupation, and are interesting in other ways. The report is therefore respectfully submitted with the recommendation that it be published as Bulletin No. 152 of this Office.

Respectfully,

A. C. True, *Director.*

Hon. James Wilson,
Secretary of Agriculture.

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DIETARY STUDIES OF HARVARD STUDENTS.

INTRODUCTION.

In connection with regular university work a study was made of dietary conditions at Randall Hall, which is the smaller of the two large college commons of Harvard University and furnishes board for 1,000 students. The institution is self-supporting and managed by the student boarders with the cooperation of the college authorities, and is designed to aid students of limited means, the object being to furnish board on the European or a la carte plan at the lowest possible figure.

The results of the study above mentioned, although rendered somewhat doubtful by certain necessary assumptions, seemed to establish a strong probability that some of the students boarding at Randall Hall were living and working creditably upon a daily ration considerably below the accepted standards for men of sedentary habits. It was thought that further and more accurate dietary investigation, with observations upon the physical and mental life of these men, might bring to light some interesting and perhaps useful facts. Accordingly the investigations reported in the following pages were undertaken.

The students examined were all in moderate circumstances; many of them paid their way through college by outside work and some had to practice the strictest economy. It would have been desirable for purposes of comparison to include several men to whom economy in the matter of diet was no object; but the small compensation that it was possible to hold out to them was not sufficient to induce such men to serve as subjects. All those who agreed to serve were earnest and interested in the work, and it is largely due to their patient cooperation that the carrying out of the investigation was made possible.

GENERAL PLAN.

Ten students (designated for convenience A, B, C, etc.) who lived at Randall Hall, and whose board bills ranged from medium to very low sums, were chosen as subjects. These men were put under examination simultaneously three times during the college year for periods of three weeks each. The first period began with breakfast on November 30, 1900; the second period February 14, 1901, and the third or last period May 8, 1901. During each period of study such daily records were kept as were necessary for computing the dietaries and each subject was required to present himself at the beginning and end of each period of observation to Dr. E. A. Darling, instructor in hygiene in Harvard University, for medical examination and to Dr. D. A. Sargent, director of the Hemenway Gymnasium at Harvard University, for strength tests. At the end of the academic year the grades attained by the men in their respective studies were obtained from the college office.

From such data the diet may be computed and the relative bodily strength, general health, and scholarship of the subjects may be estimated with tolerable accuracy. Briefly, then, an effort was made to measure four variables—diet, physical strength, general health, and mental performance. Obviously but one of these variables—the diet—is capable of measurement in physical units; the other measurements being necessarily in the nature of estimates, which are, however, approximately comparable for the different subjects.

THE SYSTEM AT RANDALL HALL.

Unlike most college commons, Randall Hall has no fixed rate for board. The cost to each student depends solely upon what he orders. Sugar, salt, and water are the only things which are served free. The building and equipment, designed especially for their present purpose, are comparatively new. During the college year covered by this investigation about 1,000 students were members of the Randall Hall Dining Association, which means that they had the privilege of boarding at Randall Hall.

Dividing the average money expenditure for one week by the number of boarders gives $2.24 as the average weekly price of board for the whole institution, on the assumption that all members were regular boarders taking three meals a day throughout the college year of thirty-five weeks. This figure is probably too low, because the assumption that all members of the association were regular boarders is not strictly true. The average price per week paid by the men examined in the study for the three periods was $2.66. Since the subjects were chosen from men whose board bills ranged from very low to medium amounts, it seems reasonable to conclude that the real average price paid for board at Randall Hall for the year was somewhat above $2.66 per week.

It is worth noting that the students themselves serve as waiters. In this way many of them earn the price of their board by waiting on the table several hours each day.

For each meal each table is provided with the bill of fare for the day, showing the dishes ready to serve and the prices. In addition to these the bill of fare gives the menu of so-called "combination meals." These meals served at uniform prices (breakfast and lunch 14 cents each and dinner 16 cents) furnish board on the "American plan" to those preferring it to the a la carte system. These combination meals supplied a varied diet, and from the data regarding them obtained as part of the study here reported it was calculated that a person living on them would obtain nearly the quantities of protein and energy called for by the commonly accepted standard for men having a small amount of muscular work.

In addition to the regular daily bills of fare each table is provided with an "extra-order list" giving a great variety of dishes that can be cooked to order. Comparatively few such dishes were used by the men studied.

The order slips made out and signed by the men are kept and serve as a basis for calculating the weekly board bills.

To obtain a list of the dishes eaten during the dietary studies each subject was required to write his order in a small notebook supplied for the purpose. A slip of carbon paper copied through the notebook leaf upon a regular "order slip" placed beneath, and this slip went to the serving room in the usual way. As a check the slips sent in by each subject were compared with his notebook at the end of each week. Before any student was accepted as a subject for this study he was given to understand that he was to eat no food outside of Randall Hall during the periods of examination. Unless this condition was absolutely agreed to the applicant was rejected. Beyond this there is no positive evidence that no food was eaten except that recorded in the notebooks, but there is on the other hand good reason to believe that the rule was strictly adhered to, since the men were of good character and showed interest in the work. Stress was laid upon the fact that there was no wish whatever to interfere with the tastes and dietary habits of the men and that all that was desired was simply a record of what they ate. They were asked to eat during the periods covered by the study just what they would at other times when no records were kept. Under these conditions the dietaries for the three periods of three weeks each at different times of the year are believed to represent the average diet of these men for the entire college year with tolerable accuracy.

It was impracticable to weigh all the "portions" or "orders" eaten by each student during three weeks, so the average weights of the various dishes were obtained by weighing, during each period of study or immediately after, a number of similar portions served on different days and averaging the figures so obtained. The number of portions weighed depended upon the importance of each article of food as a constituent of the diet studied and ranged from one to twelve for each article during each period of study. At the time of weighing samples of a considerable number of dishes were preserved for subsequent analysis by the addition of a few drops of formalin. The very great variety and mixed character of the food, however, necessitated frequent estimations of composition, for it was impossible to sample and analyze every dish, but such estimates were confined to unimportant foods—that is, to those not often used and to such as supplied little nutritive material.

The following table shows the cost, average weight, and amounts of protein and energy in one "portion" or "order" of the various dishes used. The table also shows which of the foods were analyzed and which had their nutritive value computed from average figures. The data recorded served as a basis for computing the individual dietaries.

TABLE 1.—*Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food.*

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
	Beef:	*Per ct.*	*Cal.*	*No.*		*Grams.*	*Cents.*	*Grams.*	*Cal.*
1	Boiled[c]	28.0	2.63	....	....	135	10	38	355
2	Braised[c]	28.0	2.63	....	....	327	10	92	860
3	Corned[b]	26.3	3.26	2	2	105	8	28	342
4	Do.[b]	26.3	3.26	3	2	108	8	28	352
5	Average	26.3	3.26	....	4	106	8	28	346
6	Roast[a]	24.1	3.16	1	5	82	10	20	259
7	Do.[b]	24.1	3.16	2	2	92	10	22	291
8	Do.[b]	24.1	3.16	3	7	86	10	21	272
9	Stew[a]	23.7	2.10	1	2	327	10	78	687
10	Steak[a]	30.9	2.97	1	3	98	10	30	291
11	Do.[b]	30.9	2.97	2	5	115	10	36	342
12	Do.[b]	30.9	2.97	3	5	109	10	34	324
13	Hamburg steak[b]	28.0	2.63	2	1	133	10	37	350
14	Rump steak[b]	23.5	3.27	2	1	175	20	41	572
15	Tenderloin[b]	23.5	3.27	2	1	208	50	49	680
16	Tongue[c]	12.8	2.67	....	....	108	10	14	288
17	Tripe[c]	11.7	.78	....	....	125	10	15	98
18	Croquettes[b]	28.0	2.63	1	1	279	10	78	734
19	Do.[b]	28.0	2.63	2	1	234	10	66	615
20	Hash[b]	12.0	1.78	1	2	171	7	21	304
21	Do.[b]	12.0	1.78	2	2	170	7	20	303
22	Do.[b]	12.0	1.73	3	2	265	6	32	472
23	Frizzled beef with eggs[b]	10.7	1.54	1	1	177	10	19	273
23a	Do.[a]	10.7	1.54	2	1	154	10	17	237
24	Do.[b]	10.7	1.54	3	1	112	9	12	172
24a	Average	10.7	1.54	....	3	148	10	16	227
25	Potpie[a]	17.3	3.13	1	2	265	10	46	829
26	Do.[b]	17.3	3.13	2	2	220	10	38	689
	Veal:								
27	Cutlets[b]	31.0	2.39	2	1	136	15	42	325
28	Roast,[b] with gravy and dressing[a] (see reference No. 29)	31.0	2.39	2	1	127	10	39	304
29	Gravy and dressing with roast[b] (see No. 28)	1.9	.78	2	1	86	[r]0	2	67
30	Venison potpie[c]	17.3	3.13	....	....	265	10	46	829
	Mutton and lamb:								
31	Chops[b]	21.7	4.07	2	1	73	[q]25	16	297
32	Roast[b]	19.7	2.32	1	1	75	10	15	174
33	Do.[b]	19.7	2.32	2	2	124	10	24	288
34	Do.[b]	19.7	2.32	3	1	120	10	24	278
35	Roast, cold[b]	19.7	2.32	2	1	106	10	21	246
36	Tongue[b]	12.8	2.67	2	1	108	10	14	288
37	Croquettes[c]	21.7	4.07	1	....	257	10	56	1,046
38	Minced[c] (with toast[v]) (see No. 140)	19.7	2.32	....	....	135	8	27	313

TABLE 1.—*Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food*—Continued.

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
		Per ct.	*Cal.*	*No.*		*Grams.*	*Cents.*	*Grams.*	*Cal.*
	Pork:								
39	Bacon[b] with eggs[e] (see No. 78)	22.7	7.31	1	1	31	4	7	227
40	Do.[b]	22.7	7.31	2	1	43	4	10	314
41	Do.[b]	22.7	7.31	3	1	26	4	6	190
42	Chops[c]	21.1	6.62	....	....	190	10	40	1,258
43	Cutlets[b] with fried apples[a] (see No. 242)	21.1	6.62	2	1	194	15	41	1,284
44	Ham, cakes[c]	22.2	4.41	....	....	195	10	43	860
45	Ham, fried[b]	22.2	4.41	2	2	80	10	18	353
46	Do.[b]	22.2	4.41	3	1	68	10	15	300
47	Ham hashed with eggs[b]	22.5	3.27	3	1	195	10	44	638
48	Ham fried[c] (with eggs[e]) (see No. 78)	22.2	4.41	....	....	80	12	18	353
49	Ham boiled[c] (with eggs[e]) (see No. 78)	20.2	3.28	1	....	76	10	15	249
50	Sausage[b]	19.8	6.27	2	2	116	8	23	727
	Poultry:								
51	Chicken pie[b]	21.8	2.43	1	1	233	12	51	566
52	Chicken wings[b] with toast[a] (see No. 139)	17.6	2.18	2	1	94	10	17	205
53	Chicken wings[b] with toast[a]	17.6	2.18	3	1	85	10	15	185
54	Turkey, roast, with dressing[a]	20.2	1.86	1	1	245	15	49	456
55	Do.[b]	20.2	1.86	2	2	287	15	58	534
56	Do.[b]	20.2	1.86	3	2	298	15	60	554
	Soups:								
57	Chowder[a]	2.5	.53	2	4	246	3	6	130
58	Puree of peas[a]	4.0	.95	2	3	189	3	8	180
59	Soups[a]	2.8	.44	1	8	193	3	5	85
60	Do.[a]	1.8	.26	2	8	213	3	4	55
61	Do.[d]	2.9	.45	3	....	203	3	6	91
	Fish:								
62	Bass and cod, fried[c]	25.9	1.89	....	....	140	[t]10	36	265
63	Halibut, fried[b]	32.6	4.08	2	2	140	10	46	571
64	Mackerel, broiled[b]	21.8	1.80	3	4	145	10	32	261
65	Smelts, fried[b]	25.9	1.89	1	1	121	10	31	229
66	Sea trout, fried trout, baked whitefish[b]	25.9	1.89	3	1	[n]122	10	32	231
67	Lobsters, boiled[b]	18.1	1.15	2	1	98	25	18	113
68	Oysters, raw, 1 dozen[c]	6.0	.59	....	....	200	15	12	118
69	Oysters, fried[c]	6.0	.59	....	....	114	25	7	67
70	Oyster stew, ordinary[a]	4.1	.54	1	1	197	10	8	106
71	Do.[b]	4.1	.54	2	1	257	10	11	139
72	Oyster stew, special[a]	3.8	.57	2	2	420	15	16	239
73	Oyster pie[c]	17.3	3.13	....	....	220	12	38	689
74	Scallops, fried[b]	25.4	1.54	1	1	106	10	27	163
75	Shrimp salad with dressing[b]	25.4	1.54	3	1	183	15	46	282
76	Fish balls[b]	12.9	2.11	1	2	158	5	20	333
76a	Do.[b]	12.9	2.11	2	1	149	5	19	314
	Eggs, hens':								
77	2 raw, boiled, and dropped[c]	13.1	1.64	....	....	101	[e]8	13	166
78	2 fried,[b l]	13.0	2.45	1	1	94	8	12	230
79	Do.[c]	13.0	2.45	2	....	87	8	11	213
80	Do.[a]	13.0	2.45	3	3	85	6	11	208
81	Omelet[b]	12.3	2.42	1	1	158	10	19	382
82	Do.[b]	12.3	2.42	2	3	188	10	23	455
83	Do.[a]	12.3	2.42	3	6	158	8	19	382
84	Scrambled[b]	24.1	5.20	1	1	168	10	40	874
85	Do.[b]	24.1	5.20	2	3	147	10	35	764
86	Do.[a]	24.1	5.20	3	6	176	8	42	915
	Dairy products:								
87	Butter[b]	1.0	7.92	1	11	12	1	....	95
88	Do.[b]	1.0	7.92	2	3	12	1	....	95
89	Do.[b]	1.0	7.92	3	7	13	1	....	103
90	Cheese[b]	25.9	4.68	2	1	20	1	5	94
91	Cheese, sage[b]	25.9	4.68	1	1	17	1	4	80
92	Cream[b]	2.5	2.03	3	3	65	2	2	132
93	Cream[b] with strawberries (see No. 256)	2.5	2.03	3	7	45	[r]0	1	91
94	Milk, bowl[b]	3.5	.76	3	3	346	[j]4	12	263
95	Milk, glass[a]	3.5	.76	1	12	188	2	7	143
96	Milk, pitcher[b]	3.5	.76	1	9	101	1	4	77
	Breakfast cereals, etc.:								
97	Prepared cereal[b]	11.7	4.15	1	3	68	4	8	282
98	Do.[b]	11.7	4.15	2	4	56	4	7	232
99	Do.[b]	11.7	4.15	3	3	68	4	8	282

TABLE 1.—*Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food*—Continued.

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
		Per ct.	*Cal.*	*No.*		*Grams.*	*Cents.*	*Grams.*	*Cal.*
	Breakfast cereals, etc.—Continued.								
100	Hominy, boiled[a]	1.8	0.85	1	4	203	4	4	173
101	Do.[b]	1.8	.85	2	4	199	3	4	169
102	Do.[b]	1.8	.85	3	5	191	3	3	162
103	Oatmeal, boiled[a]	3.7	1.03	1	5	206	4	8	212
104	Do.[a]	2.3	.65	2	4	220	3	5	143
105	Do.[b]	3.0	.84	3	4	226	3	7	190
106	Rice, boiled[a]	2.5	1.17	1	3	148	4	4	173
107	Do.[b]	2.5	1.17	2	3	129	3	3	151
108	Do.[b]	2.5	1.17	3	5	142	3	4	166
109	Shredded wheat biscuits, 2[c]	10.5	4.01	....	....	56	4	6	225
110	Wheat, boiled[a]	2.0	.73	2	5	229	3	5	167
111	Do.[b]	2.0	.73	3	2	233	3	5	170
112	Average	2.0	.73	....	7	231	[k]3	5	169
	Bread, crackers, etc.:								
113	Bread, white[b]	9.2	2.88	1	9	64	1	6	184
114	Do.[b]	9.2	2.88	2	10	64	1	6	184
115	Do.[b]	9.2	2.88	3	10	68	1	6	196
116	Bread, Graham[b]	8.9	2.87	1	8	68	1	6	195
117	Do.[b]	8.9	2.87	2	10	70	1	6	201
118	Do.[b]	8.9	2.87	3	11	66	1	6	189
119	Bread, corn[b]	7.9	2.84	1	6	43	1	3	122
120	Do.[b]	7.9	2.84	2	10	50	1	4	142
121	Do.[b]	7.9	2.84	3	10	44	1	3	125
122	Bread, Boston brown[b]	5.4	2.46	1	1	191	2	10	470
123	Do.[b]	5.4	2.46	2	2	181	2	10	445
124	Do.[b]	5.4	2.46	3	1	141	2	8	347
125	Biscuit, soda[b]	9.3	4.02	1	4	58	1	5	233
126	Do.[b]	9.3	4.02	2	4	49	1	5	197
127	Do.[b]	9.3	4.02	3	6	51	1	5	205
128	Gems, Graham[b]	8.9	2.87	2	8	37	1	3	106
129	Do.[b]	8.9	2.87	3	6	38	1	3	109
130	Average	8.9	2.87	....	14	38	1	3	109
131	Rolls[b]	9.0	3.08	1	15	49	1	4	151
132	Do.[b]	9.0	3.08	2	18	48	1	4	148
133	Do.[b]	9.0	3.08	3	17	55	1	5	169
134	Toast, dry[c]	11.5	3.39	....	....	55	2	6	186
135	Toast, buttered[a]	9.0	4.11	2	5	74	3	7	304
136	Do.[b]	9.0	4.11	3	5	66	3	6	271
137	Average	9.0	4.11	....	10	70	3	6	288
138	Toast, creamed[c]	9.2	2.88	....	....	70	[m]7	6	202
139	Toast[b], with chicken wings (see No. 52)	11.5	3.39	2	1	46	[r]0	5	156
140	Toast[c], with eggs and with minced lamb (see Nos. 77 and 38)	11.5	3.39	....	....	27	2	3	91
141	Toast[b], with asparagus (see No. 218)	11.5	3.39	3	2	25	[r]0	3	85
142	Scones[b]	9.3	4.02	2	3	40	1	4	161
143	Buckwheat cakes[b]	7.1	2.09	1	1	135	5	10	282
144	Do.[b]	7.1	2.09	2	1	156	5	11	326
145	Griddlecakes[b]	7.1	2.09	2	3	161	5	11	336
146	Do.[a]	7.1	2.09	3	5	192	4	14	401
147	Average	7.1	2.09	....	8	177	5	13	370
148	Crackers, Graham[b]	10.0	4.55	1	1	52	3	5	237
149	Do.[b]	10.0	4.55	2	1	55	3	6	250
150	Oyster crackers[b]	11.3	4.59	1	1	46	2	5	211
151	Do.[b]	11.3	4.59	2	3	51	2	6	234
152	Crackers for soup[b]	11.3	4.59	1	7	46	1	5	211
153	Do.[b]	11.3	4.59	2	4	44	1	5	202
154	Average	11.3	4.59	....	11	45	1	5	207
155	Macaroni[a]	3.9	1.16	1	3	199	7	8	231
156	Do.[b]	3.9	1.16	3	3	226	6	9	262
157	Average	3.9	1.16	....	6	213	7	8	247

TABLE 1.—*Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food*—Continued.

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
	Desserts, etc.:	*Per ct.*	*Cal.*	*No.*		*Grams.*	*Cents.*	*Grams.*	*Cal.*
158	Cake,[b] average of several kinds[h]	6.3	3.89	1	5	47	1	3	183
159	Do.[b]	6.3	3.89	2	9	44	1	3	171
160	Do.[b]	6.3	3.89	3	3	50	1	3	194
161	Cookies[b]	7.0	4.35	1	2	32	1	2	139
162	Do.[b]	7.0	4.35	2	6	33	1	2	144
163	Do.[b]	7.0	4.35	3	2	38	1	3	165
164	Doughnuts[b]	6.7	4.61	1	3	47	1	3	217
165	Do.[b]	6.7	4.61	2	2	38	1	3	175
166	Do.[b]	6.7	4.61	3	1	49	1	3	226
167	Eclairs[b]	4.1	1.87	2	2	146	4	6	273
168	Gingerbread[b]	5.8	3.84	1	6	43	1	2	165
169	Do.[b]	5.8	3.84	2	6	46	1	3	177
170	Do.[b]	5.8	3.84	3	3	49	1	3	188
171	Fritters, apple[c]	3.1	2.86	2	5	158	7	5	452
172	Pies,[b] average of several kinds[h]	4.1	2.94	1	2	172	5	7	506
173	Do.[b]	4.1	2.94	2	5	158	5	6	465
174	Do.[b]	4.1	2.94	3	8	150	4	6	441
175	Puddings,[a] average of several kinds[h].	4.1	1.87	1	13	183	5	8	342
176	Do.[b]	4.1	1.57	2	11	187	4	8	294
177	Do.[b]	4.1	1.72	3	1	172	4	7	296
178	Pudding, Indian[b]	5.5	1.90	3	1	150	4	8	285
179	Strawberry shortcake[b], berries[u] (see No. 180).	1.0	.40	3	2	82	7	1	33
180	Strawberry shortcake,[b] crust (see No. 179).	6.3	3.89	3	2	126	[r] 0	8	490
181	Tarts, damson, raspberries, etc.[b]	4.1	2.94	2	3	78	2	3	229
182	Ice cream[b]	2.7	2.09	1	1	120	7	3	251
183	Do.[b]	2.7	2.09	2	2	138	7	4	288
184	Do.[b]	2.7	2.09	3	4	114	7	3	238
185	Jelly, coffee[a]	2.8	1.01	1	3	127	4	4	128
186	Do.[b]	2.8	1.01	2	5	115	4	3	116
187	Do.[b]	2.8	1.01	3	4	119	4	3	120
188	Sherbet[c]	......	1.28	1	....	76	6	....	97
	Vegetables:								
189	Beans, baked[a]	8.2	1.53	1	5	209	4	17	320
190	Do.[b]	8.2	1.53	2	4	226	4	19	346
191	Do.[b]	8.2	1.53	3	4	198	4	16	303
192	Beans, Lima[b]	7.2	1.15	1	2	88	3	6	101
193	Do.[a]	7.2	1.15	2	2	95	3	7	109
194	Do.[b]	7.2	1.15	3	2	90	2	6	104
195	Beans, wax[b]	1.0	.20	3	2	64	2	1	13
196	Peas[b]	3.6	.64	2	3	81	3	3	52
197	Do.[b]	3.6	.64	3	3	85	2	3	54
198	Average	3.6	.64	....	6	83	3	3	53
199	Potatoes, baked[b]	2.6	1.05	1	4	141	2	4	148
200	Do.[b]	2.6	1.05	2	12	149	2	4	156
201	Do.[b]	2.6	1.05	3	7	129	2	3	135
202	Potatoes, boiled[b]	2.5	1.01	3	4	143	2	4	144
203	Potatoes, mashed[b]	2.6	1.16	1	5	136	2	4	158
204	Do.[b]	2.6	1.16	2	6	141	2	4	164
205	Do.[b]	2.6	1.16	3	6	143	2	4	166
206	Potatoes, stewed[c]	2.5	1.01	....	....	143	2	4	144
207	Potatoes, fried[d]	3.4	2.55	1	....	125	2	4	319
207a	Do.[a]	3.4	1.94	2	5	119	2	4	231
208	Do.[b]	3.4	2.25	3	3	130	2	4	292
209	Potatoes, French fried[b]	3.4	2.25	3	3	85	5	3	191
210	Potatoes, German fried, and griddled[c].	3.4	2.25	....	....	130	[f] 2	4	292
211	Potatoes, lyonnaise[b]	3.4	2.25	1	2	88	[s] 2	3	198
212	Do.[b]	3.4	2.25	3	4	112	2	4	252
213	Average	3.4	2.25	....	6	100	2	3	225
214	Potatoes, hashed, brown[b]	3.4	2.25	3	1	179	2	6	403
215	Potato salad[b]	2.5	1.01	2	1	117	5	3	118
216	Sweet potatoes, boiled and baked[b]	3.0	2.11	1	3	185	2	6	390
217	Do.[b]	3.0	2.11	2	5	183	2	5	386
218	Asparagus,[b] with toast[u] (see No. 141)	1.5	.20	3	2	60	8	1	12
219	Beets, pickled[b]	2.3	.44	3	1	83	3	2	37
220	Cabbage[b]	1.6	.34	2	1	108	3	2	37
221	Do.[b]	1.6	.34	3	1	147	2	2	50

TABLE 1.—*Percentage of protein, amount of energy per gram, and average weight, cost, amount of protein, and energy per order of different kinds of food*—Continued.

Reference number.	Kind of food.	Proportion of protein.	Energy per gram.	Period in which used.	Number of orders weighed.	Average per order.			
						Weight.	Cost.	Protein.	Energy.
	Vegetables—Continued.	*Per ct.*	*Cal.*	*No.*		*Grams.*	*Cents.*	*Grams.*	*Cal.*
222	Celery [c]	1.1	0.20	....	....	75	5	1	15
223	Corn, stewed [b]	2.8	1.05	1	1	78	3	2	82
224	Do. [b]	2.8	1.05	2	1	63	3	2	66
225	Do. [b]	2.8	1.05	3	4	83	2	2	87
226	Onions, raw [b]	1.6	.52	3	1	81	3	1	42
227	Onions, boiled [b]	1.2	.43	3	2	91	3	1	39
228	Radishes [b]	1.3	.32	3	2	66	4	1	21
229	Spinach [c]	2.1	.60	....	....	125	2	3	75
230	Succotash [b]	3.6	1.05	1	2	90	3	3	95
231	Do. [b]	3.6	1.05	3	3	91	2	3	96
232	Tomatoes, stewed [b]	1.2	.25	2	3	107	3	1	27
233	Do. [b]	1.2	.25	3	4	89	2	1	22
234	Average	1.2	.25	....	7	98	3	1	24
235	Turnips [b]	1.3	.60	3	1	168	[g]2	2	101
236	Hash, vegetable [c]	3.4	2.25	....	....	179	6	6	403
237	Pickles, sweet [c]	1.1	.25	....	....	67	5	1	17
238	Pickles [b]	1.1	.25	2	1	67	1	1	17
239	Do. [b]	1.1	.25	3	2	58	1	1	15
	Fruits:								
240	Apples [b]	.3	.48	2	6	127	2	.4	61
241	Apples, baked [c]	.6	.77	....	....	157	4	1	121
242	Apples, [b] fried, with pork cutlets (see No. 43)	.2	1.57	2	1	63	[r]0	....	99
243	Bananas [b]	.8	.65	2	6	155	2	1	101
244	Do. [b]	.8	.65	3	6	140	2	1	91
245	Average	.8	.65	....	12	148	2	1	96
246	Cherries, canned [b]	1.1	.91	2	1	85	4	1	77
217	Grapes [b]	1.0	.74	1	1	105	3	1	78
248	Do. [b]	1.0	.74	2	1	185	5	2	137
249	Figs, dried [b]	4.3	3.22	2	1	87	4	4	280
250	Oranges [b]	.6	.38	2	6	228	3	1.4	87
251	Do. [b]	.6	.38	3	6	234	3	1.4	89
252	Average	.6	.38	....	12	231	3	1.4	88
253	Peaches, canned [b]	.7	.48	2	1	69	4	....	33
254	Prunes, stewed [b]	.6	1.16	1	2	112	4	1	130
255	Do. [b]	.6	1.16	3	2	94	4	1	109
256	Strawberries [b] with cream [u] (see No. 93)	1.0	.40	3	7	135	[o]7	1	54
257	Preserves, [a] average of several kinds [h]	.5	2.45	2	4	66	4	....	162
258	Sauces, [b] average of several kinds [h]	.7	.81	3	3	98	4	1	79
	Sugars, etc.:								
259	Sugar, teaspoonfuls [c]	....	3.95	....	....	9	[r]0	....	36
260	Sirup [c]	....	2.77	....	....	75	2	....	208
261	Honey [c]	....	3.21	....	....	75	4	....	241
	Beverages: [p]								
262	Cocoa [d]	1.1	.31	....	....	184	3	2	57
263	Coffee [d] and tea [d]	.8	.17	....	....	184	3	1	31
264	Cereal coffee [c]	.2	.07	....	....	184	3	....	13
265	Chocolate [d]	2.1	.72	....	....	184	5	4	132
266	Birch beer, ginger ale, sarsaparilla [c]	....	.45	....	....	225	5	....	101
267	Lemonade [c]	....	.45	....	....	200	2	....	90
	Combination meals: [i]								
268	Breakfasts	4.6	1.25	1	....	570	10	26	710
269	Do	4.2	1.34	2	....	591	10	25	790
270	Do	4.4	1.34	3	....	545	10	24	728
271	Lunches	4.9	1.70	1	....	534	10	26	908
272	Do	6.4	1.99	2	....	499	10	32	993
273	Do	4.0	1.58	3	....	428	10	17	675
274	Dinner	6.1	1.46	1	....	527	12	32	769
275	Do	5.7	1.33	2	....	531	12	30	704
276	Do	5.2	1.39	3	....	459	12	24	638

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[a] Percentage of protein, energy per gram, and average weight per order actually determined.

[b] Percentage of protein and energy per gram, estimated, either from analyses of similar materials previously published (U. S. Dept. Agr., Office of Experiment Stations Buls. 28 and 75), or from

determinations made in connection with these studies, on materials sampled in one period but used in another. Average weight per order actually found.

[c] Percentage of protein, energy per gram, and average weight per order, all estimated from corresponding data for similar materials.

[d] Percentage of protein and energy per gram actually determined, but average weight per order estimated from that of similar materials.

[e] The cost per order decreased 2 cents in period 3.

[f] "German fried" potatoes cost 2 cents, but "griddled" cost 10 cents per order.

[g] In periods 1 and 2 the cost per order was 3 cents.

[h] The average weight per order of pie was ascertained from the weighings of a number of orders of different kinds of pie. When the subject used several kinds during the same period, this average weight was used in computing the amount of protein and energy obtained; but when only one kind was used, the weight per order of that particular kind was taken for the computation. The same is true of preserves, puddings, sauces, and cake. The cost per order of cake is here given as 1 cent, since that was the price in the majority of cases. For some kinds, however, the cost was larger; consequently the total cost for cake given in the tables of some of the studies is not equal to the number of orders times the price here given. These differences are noted in the tables beyond.

[i] In the case of the combination meals, as here tabulated, the figures for percentage of protein, energy per gram, cost, and weight per order do not include the corresponding data for the bread and the tea, coffee, or milk that always formed part of such meals. Since the quantity of both the bread and the drink with the meal was the same as in the usual "orders" of these materials they may be recorded with separate orders of the same materials, and in computing the results of the studies it was found more convenient to record them thus. Accordingly, the price of the combination meals as actually served is here reduced by the price of the bread and the drink deducted. The proportion of protein and energy per gram of the combination meals, minus the bread and drink, were ascertained from the amount, protein content, and energy value of the various materials that were included. For the most part these data were obtained by actual determinations on samples of the materials, though in the case of a few of the less important materials the data were estimated.

[j] Hot milk cost 5 cents per bowl.

[k] The cost per order was 4 cents in period 1.

[l] Sometimes formed part of an order, with bacon or ham. See note *u*.

[m] The cost per order decreased 1 cent in period 3.

[n] The weight per order of sea trout was 120 grams.

[o] The cost per order of strawberries varied from week to week during the same period. The total cost for this item in any study is that of the total number of orders at the price actually paid rather than at the average price here given.

[p] Tea and coffee that contained neither milk nor sugar were assumed to contain no nutrients.

[q] A special order.

[r] In the case of sugar there was no charge. In the case of other materials thus marked the cost was included elsewhere, as shown by the cross references.

[s] The regular price of lyonnaise potatoes was 2 cents per order, but in a few cases some special orders that cost 5 cents each were served.

[t] Fried bass cost 10 cents, fried cod 11 cents, per order.

[u] and [v] Some orders included more than one kind of food material, each of different composition; for example, ham and eggs (No. 48) or veal with gravy and dressing (No. 28). To calculate the quantity of protein and energy in the whole order it was necessary to ascertain the weight, percentage of protein, and energy per gram for each kind of material. In the case of such orders as veal and dressing, where the one was always accompanied by the other, the cost per order is given with the main item, and the other is marked 0. In the case of such orders as ham and eggs, where either part could be ordered separately, the cost of each part is given by itself.

Where average figures are given in the table above, the average figures in the last two columns are obtained by multiplying the average weight per order by the average percentage of protein and energy per gram rather than by summing the individual items and dividing by the number of items.

With the foregoing data regarding the weight, cost, and amounts of protein and energy for one average order of each of the various dishes at our disposal, and having in addition a record of the number of times each dish was eaten by the man in question, the calculation of the daily ration becomes possible. In making such calculations, however, it is very essential that the information given in the footnotes to the table above be also taken into consideration. The tables following the explanatory data given in the account of each dietary study beyond show the cost and the amounts of protein and energy in the average food eaten daily during the periods included. The numbers in parentheses after the names of the foods refer to the places where those articles may be found in Table 1 above. The second number indicates the number of orders eaten and the third shows the total cost of the orders. For example, in Table 3 we find the item "chowder (57), 2, 6 cents," which means that the composition, cost, etc., of an order of chowder may be found by looking up No. 57 in Table 1, that two orders were eaten, and that the total cost was 6 cents.

In the tables showing the results of the studies all food materials are grouped under 13 general classes, viz, soups, dairy products, cereals, breads, desserts, vegetables, fruits, beverages, combination meals, sugars (ordinary sugar and sirup), meats (including hash, unless otherwise itemized), fish, and eggs. Combination meals appear without bread and beverages and represent the characteristic part of the meal only. It is the custom at Randall Hall to serve with the combination meals several kinds of bread, and tea, coffee, or milk at the option of the individual. Since the size of the portions of bread and the quantity of the beverages are the same as when ordered separately, these may be recorded as if separate from the combination meals and, both for the sake of convenience and in order that the different kinds of food materials might, so far as possible, be grouped according to their respective classes, this method was followed in the tables. The actual value of a combination meal as served is greater than would appear from the figures in the tables by the nutrients contained in that particular selection of bread and drink which accompanied the meal; the cost likewise is greater by 2 cents. On the other hand, the figures indicating the nutrients and energy furnished by separate orders of breads and beverages are necessarily too high by the same amount that the combination meals appear too low, and the same applies to the cost. However, it is plain that the matter is simply one of distribution, the final value of the ration being, of course, unaffected.

The data showing the nutritive value of the diet are calculated on the basis of digestible protein and available energy in addition to the more usual basis which refers to amounts eaten. The figures for digestible protein and available energy were included and used in the discussion because it was believed that these data could be calculated with reasonable accuracy by means of factors, and that the results so obtained offered a more satisfactory basis for comparison and discussion than the statistics of quantities eaten.

The factors or coefficients employed for digestibility of protein and availability of energy were deduced from the results of a large number of studies carried on in connection with the nutrition investigations of the Office of Experiment Stations and other similar work, and are given in Table 2 below. Their accuracy, the importance of many of them, the relation between digestible or available nutrients and nutrients eaten, and related topics have been discussed in detail by Atwater[a] and by Atwater and Bryant,[b] and also referred to in earlier bulletins of this series.[c]

The figures show how much of the protein of different foods and food groups is digested—that is, taken up by the body and utilized.

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[a] Connecticut Storrs Station Rpt. 1899, p. 69.

[b] Ibid., p. 73.

[c] U. S. Dept. Agr., Office of Experiment Stations Buls. 126, p. 19, and 136, p. 105.

In a similar way the figures for energy show how much of the total energy of the food has been made available for the uses of the body in the processes of digestion and assimilation.

TABLE 2.—*Coefficients of digestibility of protein and availability of energy of different classes of food materials.*

Class of food.	Protein.	Energy.
	Per cent.	*Per cent.*
Soups	97	86
Meats	97	87
Fish	97	85
Eggs	97	89
Dairy products	97	93
Breakfast cereals	85	91
Bread, crackers, etc	85	91
Desserts	85	93
Vegetables	83	91
Fruits	85	88
Sugars	....	98
Beverages	97	98
Combination meals	92	92

DETAILS OF THE DIETARIES.

In the following pages the details of the dietary studies with the ten students are recorded.

DIETARY STUDY NO. 401.

The subject of dietary study No. 401, who is designated A, was 31 years of age[a], 5 feet 1.8 inches in height, and weighed 106.7 pounds. In physical development and state of nutrition he was decidedly below the average, as was also the case with his bodily strength. He was a student in the graduate school, his course being exclusively mathematical and rather difficult. He slept 7 or 8 hours, and devoted one-half hour to gymnasium exercise or walked 30 minutes to 2 hours daily. The main part of his day was spent at intellectual work, averaging 8 to 10 hours. There was practically no change in the programme throughout the year.

The following table shows the results for the three periods of the dietary study and the average results for the whole investigation.

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[a] This and all similar data refer to values at the beginning of the experimental period.

TABLE 3.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 401.*

SUBJECT A.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Chowder (57), 2, 6 cents; soup (59), 13, 39 cents. Total soups, etc	2.1	3.9	65	3.8	56
Cheese, sage (91), 1, 1 cent; butter (87), 41, 41 cents; milk, glass (95), 15, 30 cents; milk, bowl (hot) (94), 1, 5 cents; milk, 4-ounce pitchers (96), 30, 30 cents. Total dairy products	5.1	10.7	413	10.4	384
Prepared cereal (97), 2, 8 cents; hominy (100), 2, 8 cents; oatmeal (103), 21, 84 cents; rice (106), 5, 20 cents. Total breakfast cereals, etc	5.7	9.6	297	8.2	270
Bread, white (113), 13, 13 cents; bread, Graham (116), 89, 89 cents; bread, Boston brown (122), 6, 12 cents; Graham gems (130), 8, 8 cents; crackers for soup (152), 15, 15 cents; bread, corn (119), 5, 5 cents; rolls (131), 6, 6 cents; biscuit (125), 8, 8 cents. Total breads, crackers, etc	7.4	41.4	1,429	35.2	1,300
Cake (158), 4, 8[a] cents; gingerbread (168), 1, 1 cent; pie (172), 2, 10 cents. Total desserts, etc	.9	1.3	91	1.1	85
Potatoes, baked (199), 11, 22 cents; sweet potatoes (216), 4, 8 cents; succotash (230), 1, 3 cents. Total vegetables	1.6	3.1	156	2.6	142
Bananas (245), 1, 2 cents; oranges (252), 2, 6 cents. Total fruits	.4	.2	13	.2	11
Sugar, teaspoonfuls (259), 140, 0[b]	....	....	237	....	232
Cereal coffee (264) 5, 15 cents; cocoa (262), 9, 27 cents. Total beverages	2.0	1.0	27	1.0	27
Combination lunches (271), 6, 60 cents; dinners (274), 6, 72 cents. Total combination meals	6.3	16.7	479	15.4	441
Total food	31.5	87.9	3,207	77.9	2,948
Period 2, 3 weeks, February 14 to March 6.					
Beefsteak pie (26), 1, 10 cents	.5	1.8	33	1.8	29
Chowder (57), 1, 3 cents; soup (60), 3, 9 cents. Total soups, etc	.6	.9	14	.9	12
Butter (88), 45, 45 cents; milk, glass (95), 17, 34 cents; milk, 4-ounce pitchers (96), 39, 39 cents. Total dairy products	5.6	12.1	462	11.7	430
Prepared cereal (98), 9, 36 cents; oatmeal (104), 21, 63 cents; rice (107), 2, 6 cents; wheat (110), 7, 21 cents. Total breakfast cereals, etc	6.0	9.7	313	8.2	285
Bread, Graham (117), 103, $1.03; bread, Boston brown (123), 5, 10 cents; biscuit (126), 2, 2 cents. Total bread, crackers, etc	5.5	33.3	1,110	28.3	1,010
Pie (173), 1, 5 cents; tarts (181), 1, 2 cents. Total desserts	.3	.4	33	.3	31
Potatoes, baked (200), 9, 18 cents; potatoes, boiled (202), 1, 2 cents; sweet potatoes (217), 11, 22 cents. Total vegetables	2.0	4.7	276	3.9	251
Oranges (250), 20, 60 cents	2.9	1.3	82	1.1	72
Sugar, teaspoonfuls (259), 146, 0[b]	....	....	247	....	242
Cocoa (262), 12, 36 cents; coffee (263), 1, 3 cents. Total beverages	1.9	1.2	34	1.2	33
Combination lunches (272), 11, $1.10; dinners (275), 2, 24 cents. Total combination meals	6.4	19.6	587	18.0	540
Total food	31.7	85.0	3,191	75.4	2,935
Period 3, 3 weeks, May 8 to May 28.					
Beef, roast (8), 3, 30 cents	1.4	3.0	39	2.9	34
Eggs, dropped (77), 10,[c] 30 cents; eggs, fried (80), 1,[c] 3 cents; eggs, scrambled (86), 1, 8 cents; egg omelet (83), 1, 8 cents. Total eggs	2.3	6.3	106	6.1	94
Chowder (57), 3, 9 cents; soup (61), 3, 9 cents. Total soups, etc	.9	1.7	32	1.6	28
Cream (with strawberries) (93), 1, 0;[b] butter (89), 35, 35 cents; milk, glass (95), 1, 2 cents; milk, bowl (94), 14, 56 cents; milk, 4-ounce pitchers (96), 31, 31 cents. Total dairy products	5.9	13.9	471	13.5	438

[a] See footnote *h* to Table 1. [b] See footnote *r* to Table 1. [c] Orders for one-half the usual amount.

TABLE 3.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 401*—Continued.

SUBJECT A—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Prepared cereal (99), 2, 8 cents; hominy (102), 1, 3 cents; oatmeal (105), 21, 63 cents; rice (108), 5, 15 cents; shredded wheat (109), 1,[a] 2 cents; wheat (111), 4, 12 cents. Total breakfast cereals, etc.	4.9	9.6	302	8.2	275
Bread, white (115), 2, 2 cents; bread, Graham (118), 98, 98 cents; bread, brown (124), 2, 4 cents; bread, corn (121), 1, 1 cent; biscuit (127), 2, 2 cents; griddlecakes (146), 1, 4 cents; toast, creamed (138), 1, 6 cents; crackers for soup (154), 1, 1 cent. Total bread, crackers, etc	5.6	30.5	999	25.9	909
Cake (160), 4, 4 cents; ice cream (184), 1, 7 cents; pie (174), 2, 8 cents; pudding (177), 4, 16 cents. Total desserts	1.7	2.7	147	2.3	137
Beans, baked (191), 2, 8 cents; potatoes, boiled (202), 1, 2 cents; potatoes, hashed (214), 1, 2 cents; potatoes, mashed (205), 3, 6 cents. Total vegetables	.9	2.5	79	2.1	72
Bananas (244), 3, 6 cents; oranges (251), 6, 18 cents; strawberries (with cream) (256), 1, 7 cents. Total fruits	1.5	.5	41	.4	36
Sugar, teaspoonfuls (259), 150, 0;[b] sirup (260), 1, 2 cents. Total sugar, etc	.1	....	264	....	259
Cocoa (262), 10, 30 cents; lemonade (267), 2, 4 cents; tea (263), 1, 3 cents. Total beverages	1.8	1.0	37	1.0	36
Combination lunches (273), 8, 80 cents; dinners (276), 5, 60 cents. Total combination meals	6.6	12.2	409	11.2	376
Total food	33.6	83.9	2,926	75.2	2,694
Average for three periods	32.3	85.6	3,108	76.2	2,859

[a] Order for one-half the usual amount.

[b] See footnote *r* to Table 1.

In regard to the diet of this subject, the most striking feature is the exceedingly small amount of meat, eggs, and fish eaten, roughly about 35 per cent of the digestible protein being derived from animal foods and 65 per cent from vegetable foods. In period 1 no meat, fish, eggs, or hash was eaten except that served in the combination meals, and such meals amounted to but a small fraction of the total diet, furnishing only about 20 per cent of the total digestible protein and 15 per cent of the total available energy.

In periods 2 and 3 the protein furnished by the meat eaten, aside from that of the combination meals, was also low, amounting to only about 2.5 to 4 per cent of the total. Eggs were eaten only in period 3, and then in double the average amount. The small amounts of meats, fish, and hash eaten by Subject A are very noticeable when comparison is made with the average for the ten subjects included in this investigation. In such an average about 13 per cent of the total cost of the average diet was for meats, fish, and hash, which furnished about 17 per cent of the total digestible protein and 5.5 per cent of the total available energy, whereas Subject A spent about 2 per cent of his total outlay on meats, fish, and hash, yielding about 2 per cent of the total digestible protein and less than 1 per cent of the total available energy. At the same time the sum spent by Subject A on cereals and on soups was about 100 per cent, and on breadstuffs 33 per cent more than the average of the subjects studied, while his expenditure for desserts was about 50 per cent and for vegetables and for beverages about 70 per cent of the average. It should be mentioned that, owing to the choice of the cheapest foods, he obtained for 1 cent spent on breadstuffs nearly 25 per cent more nutrients and on vegetables about 15 per cent more than the average for all the men studied. With the other classes of food he bought for 1 cent not far from the average amounts.

It has been pointed out that about 65 per cent of the protein was of vegetable origin. It is further true that breads and cereals together furnished by far the larger part of this protein (over 50 per cent of the total in the diet) and a like proportion of energy, the amounts from vegetables proper and fruits being very small, about 3 or 4 per cent.

The total digestible protein in the diet for the three periods averages 76.2 grams, or about 83 per cent of the commonly accepted standard for a man of sedentary habits, namely, 92 grams of digestible protein. On the other hand, the available energy averages 2,859 calories, or rather more than the standard calls for, i. e., 2,700 calories of available energy. The quantity of protein was remarkably uniform through the three periods (fall, winter, and spring), but the energy dropped from about 2,940 calories (average of fall and winter) to 2,694 calories in the spring term.

The small sum (about one-half as much as the average) spent on desserts is wise, since such foods would have furnished little protein and energy in proportion to their cost; but the 6 per cent of the average outlay per day spent on beverages might have been avoided with advantage and the sum expended for more nourishing foods. Milk is not included under the head of beverages, but appears under "dairy products." It is an economical food.

Subject A led throughout the year a regular life, with constant application to his university work. His diet was practically constant, being unusually low in protein and almost vegetarian in character. At the end of the investigation, May, 1901, he showed a gain of 7.5 pounds. As may be seen from Table 16, his general strength, as shown on the machines, and his chest, waist, and thigh measurements increased proportionately. At the beginning of the study he was classed after examination as underdeveloped and undernourished. At the end no marked change showed itself other than the increase in bodily weight. His intellectual efforts, if we may judge from the grades attained in his studies (see Table 18, p. 61), were attended with success above the ordinary. In other words, the diet of Subject A, although very low in protein and about equal to the average as regards energy, appears to have been a little more than sufficient to maintain him in equilibrium with his environment, which was essentially one calling for intellectual and not physical work.

DIETARY STUDY NO. 402.

Subject B was 20 years of age, 5 feet 3.6 inches in height, and weighed 131.8 pounds. In general development he was apparently not far from the average of his age, although in point of nutrition he was classed among the fairly well nourished. He was a freshman in the college, and Latin, German, French, history, and physics all found a place in the course he selected for the year. To his college duties he devoted 7 to 8 hours per day, including lectures, reading, and preparation. He slept 7 to 8 hours. In the fall he walked or played football one hour every other day on an average. In the winter he walked from 30 minutes to 1 hour every other day, and in the spring he played baseball for 30 minutes to 2 hours with about the same frequency. In addition to his studies and exercise, during period 1 he worked in a barber shop at odd times, and during period 2 he added to this programme by serving as a student waiter at Randall Hall for one or two hours daily for about a week. In period 3, the spring period, he did no work outside of his academic course.

Table 4.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 402.*

SUBJECT B.

[For explanation of numbers in parentheses see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beef, roast (6), 2, 20 cents; beef, pressed corned (5), 1, 8 cents; potpie (25), 1, 10 cents; beef hash (20), 5, 35 cents; pork chops (42), 1, 10 cents. Total meats, etc	4.0	12.2	213	11.8	185
Chowder (57), 1, 3 cents; soups (59), 2, 6 cents. Total soups, etc	.4	.8	14	.8	12
Smelts, fried (65), 1, 10 cents	.5	1.5	11	1.5	9
Eggs, dropped (77), 1, 8 cents; eggs, with toast (77), 2, 16 cents; egg omelet (81), 1, 10 cents. Total eggs	1.6	2.8	42	2.7	37
Butter (87), 27, 27 cents; cheese (90), 5, 5 cents; milk, bowl (94), 9, 36 cents; milk, glass (95), 3, 6 cents; milk, 4-ounce pitchers (96), 12, 12 cents. Total dairy products	4.1	9.5	322	9.2	299
Hominy (100), 7, 28 cents; oatmeal (103), 2, 8 cents; rice (106), 1, 4 cents; wheat (112), 2, 8 cents. Total cereals	2.3	2.6	102	2.2	93
Bread, white (113), 34, 34 cents; bread, Graham (116), 9, 9 cents; bread, corn (119), 17, 17 cents; rolls (131), 14, 14 cents; toast (134), 1, 2 cents; toast (with eggs) (140), 2, 4 cents; toast, buttered (137), 1, 3 cents; crackers, for soup (152), 24, 24 cents; buckwheat cakes (143), 2, 10 cents. Total bread, crackers, etc	5.6	25.5	881	21.7	802
Cake (158), 2, 2 cents; pudding, plum (175), 1, 5 cents. Total desserts	.3	.7	34	.6	32

TABLE 4.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 402.*—Continued.

SUBJECT B—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20—Cont'd.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beans, baked (189), 15, 60 cents; potatoes, fried (207), 1, 2 cents; potatoes, lyonnaise (211), 2, 4 cents; sweet potatoes (216), 1, 2 cents; hash, vegetable (236), 1, 6 cents. Total vegetables	3.5	13.3	300	11.0	273
Sirup (260), 2, 4 cents; sugar, teaspoonfuls (259), 216, 0*a*. Total sugars, etc	.2	....	385	....	377
Cereal coffee (264), 3, 9 cents; cocoa (262), 3, 9 cents; coffee (263), 7, 21 cents; tea (263), 9, 27 cents. Total beverages	3.1	1.4	34	1.4	33
Combination breakfasts (268), 4, 40 cents; lunches (271), 9, 90 cents; dinners (274), 11, $1.32. Total combination meals	12.5	33.0	928	30.4	854
Total food	38.1	103.3	3,266	93.3	3,006
Period 2, 3 weeks, February 14 to March 6.					
Beef tongue (16), 1, 10 cents; beef, tripe (17), 1, 10 cents; beef hash (21), 4, 28 cents; beefsteak pie (26), 4, 40 cents. Total meats, etc	4.2	12.5	207	12.1	180
Chowder (57), 2, 6 cents; purée of peas (58), 1, 3 cents. Total soups, etc	.4	.9	21	.9	18
Eggs (with toast) (77), 3, 24 cents	1.1	1.9	24	1.8	21
Butter (88), 22, 22 cents; cream (92), 1, 2 cents; milk, bowl (94), 11, 44 cents; milk, glass (95), 15, 30 cents; milk, 4-ounce pitchers (96), 14, 14 cents. Total dairy products	5.3	13.7	397	13.3	369
Prepared cereals (98), 5, 20 cents; hominy (101), 3, 9 cents; oatmeal (104), 2, 6 cents; rice (107), 3, 9 cents; wheat (110), 2, 6 cents. Total breakfast cereals	2.4	3.5	131	3.0	119
Bread, white (114), 30, 30 cents; bread, Graham (117), 1, 1 cent; bread, corn (120), 39, 39 cents; biscuit (126), 2, 2 cents; gems, Graham (128), 2, 2 cents; rolls (132), 15, 15 cents; toast, buttered (135), 2, 6 cents; toast (with eggs) (140), 3, 6 cents; scones (142), 1, 1 cent; macaroni (157), 1, 7 cents; griddle-cakes (145), 1, 5 cents. Total bread, crackers, etc	5.4	22.0	749	18.7	682
Cake (159), 1, 1 cent; gingerbread (169), 4, 4 cents; pie (173), 1, 5 cents. Total desserts	.5	1.0	64	.9	60
Beans, baked (190), 5, 20 cents; potatoes, lyonnaise (213), 1, 2 cents. Total vegetables	1.0	4.6	93	3.8	85
Bananas (243), 9, 18 cents	.9	.5	43	.4	38
Sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 236, 0.*a* Total sugars, etc	.1	....	409	....	401
Cocoa (262), 1, 3 cents; coffee (263), 4, 12 cents; tea (263), 1, 3 cents. Total beverages	.9	.4	10	.4	10
Combination breakfasts (269), 8, 80 cents; lunches (272), 6, 60 cents; dinners (275), 8, 96 cents. Total combination meals	11.3	30.1	854	27.7	786
Total food	33.5	91.1	3,002	83.0	2,769
Period 3, 3 weeks, May 8 to May 28.					
Beef, roast (8), 4, 40 cents; beefsteak (12), 1, 10 cents; beef hash (22), 1, 6 cents; lamb, minced (with toast) (38), 1, 8 cents; pork, chops (42), 2, 20 cents. Total meats, etc	4.0	12.2	224	11.8	195
Chowder (57), 1, 3 cents; soups (61), 4, 12 cents. Total soups, etc	.7	1.4	24	1.4	21
Mackerel (64), 5, 50 cents	2.4	7.5	62	7.3	53
Eggs (with toast) (77), 2, 12 cents	.6	1.2	16	1.2	14
Butter (89), 14, 14 cents; cream (92), 10, 20 cents; milk, bowl (94), 9, 36 cents; milk, glass (95), 3, 6 cents; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products	3.7	7.3	272	7.1	253
Prepared cereal (99), 1, 4 cents; hominy (102), 3, 9 cents; oatmeal (105), 2, 6 cents; rice (108), 5, 15 cents; wheat (111), 2, 6 cents. Total breakfast cereals, etc	1.9	2.8	111	2.4	101

a See footnote *r* to Table 1.

TABLE 4.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 402*—Continued.

SUBJECT B—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28—Continued.					
Bread, white (115), 27, 27 cents; bread, Graham (118), 3, 3 cents; bread, corn (121), 20, 20 cents; gems, Graham (129), 1, 1 cent; rolls (133), 18, 18 cents; toast, buttered (136), 2, 6 cents; toast (with eggs and with lamb) (140), 3, 6 cents; griddlecakes (146), 2, 8 cents; macaroni (156), 2, 12 cents. Total breads, crackers, etc	*Cents.* 4.8	*Grams.* 19.8	*Calories.* 650	*Grams.* 16.8	*Calories.* 592
Cake, chocolate (160), 1, 1 cent; pudding, Indian (178), 1, 4 cents; pie (174), 6, 24 cents; ice cream (184), 1, 7 cents. Total desserts	1.7	2.4	160	2.0	149
Beans, baked (191), 4, 16 cents; beets, pickled (219), 1, 3 cents; potatoes, baked (201), 2, 4 cents; potatoes, boiled (202), 4, 8 cents; potatoes, German fried (210), 2, 4 cents; potatoes, lyonnaise (212), 1, 2 cents; radishes (228), 1, 4 cents. Total vegetables	2.0	4.9	141	4.1	128
Bananas (244), 3, 6 cents; oranges (251), 1, 3 cents. Total fruits	.4	.2	17	.2	15
Sirup (260), 5, 10 cents; sugar, teaspoonfuls (259), 212, 0.[a] Total sugars, etc	.5	....	408	....	400
Cocoa (262), 1, 3 cents; coffee (263), 2, 6 cents; lemonade (267), 3, 6 cents; tea (263), 15, 45 cents. Total beverages	2.9	1.3	41	1.3	40
Combination breakfasts (270), 4, 40 cents; lunches (273), 11, $1.10; dinners (276), 7, 84 cents. Total combination meals	11.1	21.5	706	19.8	650
Total food	36.7	82.5	2,832	75.4	2,611
Average for three periods	36.1	92.3	3,033	83.9	2,795

[a] See footnote *r* to Table 1.

With a normal average diet as a basis of comparison there is nothing especially noticeable in regard to the total amounts of protein and energy in the dietary of Subject B. As regards the amount of meat, fish, and hash eaten, he spent 14 per cent of his daily outgo, exclusive of combination meals, on such foods, which is practically identical with the average for the ten men studied. In other words, the proportion of protein furnished by animal foods was 56 per cent of the total, and the energy furnished by vegetable foods about 65 per cent. The ratio of digestible protein from animal to that from vegetable sources in the average American diet has been found to be about 60 to 40 per cent, in round numbers, and the corresponding ratio for available energy 43 to 57 per cent. It is evident that the diet of this subject furnished nearly the usual proportion of animal and vegetable foods. The number of combination meals eaten was large, the amount spent for these being almost twice as great as the average for the ten men.

In the case of meats, soups, breads, dairy products, and beverages the proportional daily expenditure was very close to the average. For eggs, cereals, and vegetables it was, roughly, 75 per cent of the average, and for desserts and fruits about 35 and 25 per cent, respectively. If one's tastes permit it, this is a considerable economy, since neither desserts nor fruits furnish nutrients at a low cost. It is noticeable that liberal use was made of sugar, which, as already pointed out, was supplied without extra charge. The subject thus dispensed with the usual expenditure for sirups, etc. For the whole dietary, the quantities of digestible protein and available energy show a steady decrease toward a minimum in period 3. The average for the three periods was 84 grams digestible protein and 2,795 calories of available energy, or 91.5 and 103.5 per cent, respectively, of the quantities in the commonly accepted dietary standard for a man of sedentary habits.

Although the quantities of protein and energy in the last period were 9 and 6 per cent lower, respectively, than in period 2, the cost was about 3.3 cents, or 10 per cent higher, owing in part to a greater proportionate expenditure for fish, desserts, and beverages, which were all relatively expensive foods. A corresponding deficit occurs in the case of dairy products, cereals, and breads. Perhaps a more potent factor in this drop in the value of the ration during period 3 was the diminished buying power of 1 cent when expended on some of the more important articles. Calculations show, for example, that for 1 cent spent on combination meals in period 2, Subject B obtained 2.5 grams of digestible protein and 69.5 calories of available energy, whereas in period 3 he obtained only 1.8 grams and 58.5 calories, or, respectively, 72 per cent and 83 per cent as much. When we remember that the combination meals furnished about 30 per cent of the total nutrients, it is evident that the effect of their use on total cost must be considerable.

Since a similar falling off in the amounts of nutrients without proportionate decrease in cost was noticed not only in this particular case, but in the majority of the dietaries here reported, it is difficult to account for it on the assumption of less prudent selection of food by the men during the last period. It seems more probable that there was a gradual rise in the price of the dishes toward the end of the year, or, what amounts to the same thing, a general diminution in the weights or the proportion of nutrients in the orders.

At the end of the spring period (period 3) Subject B weighed 136 pounds, or 4.2 pounds more than at the beginning of the study. A corresponding slight increase was observed in his anthropometric measurements. His general strength as shown by the testing machines increased less than the average. In point of general physical condition no material change was noted.

As regards mental work the grades attained in his examinations were about those of the average student. However, for a man with many other duties besides those pertaining to his college course, they were creditable.

In Subject B, then, we have a young man, rather more active than the average, apparently in equilibrium with the demands of an academic life, and living on a ration which is practically identical with the standard chosen for comparison. It may be remarked that the gain in body weight (about 4 pounds) seems small when we remember that he was but 20 years old, and, therefore, probably still developing physically. It may be that his diet was not liberal enough to provide both for the energy involved in his daily life and for the material demanded by the growing body.

DIETARY STUDY NO. 403.

The subject of this study was 23 years old, 5 feet 6.1 inches in height, and weighed 145 pounds. In general development he was not far from the average. Medical examination showed that he was only fairly well nourished. Doubtless this condition was the result of a severe illness contracted during the preceding summer vacation.

Subject C was entirely dependent upon his own efforts for support and was, therefore, obliged to spend much time on outside work. He earned his lodging by attending to the furnace in a private house, and by serving from 1 to 3 hours daily as a waiter at Randall Hall he earned his board. He spent from 10 to 12 hours per day at intellectual work, including lectures, study, outside clerical work, and reading. For sleep he set aside 7 hours. During periods 1 and 2, the only physical exercise other than that involved in walking to and from lectures, meals, etc., that he found time for, was a 3-hour walk every Sunday afternoon. During period 3 he rode a bicycle 1 hour per day for 11 out of the 21 days.

Subject C was a sophomore in the college department of the university. His studies comprised German, philosophy, zoology, hygiene, physics, and chemistry, and he carried one whole course and one half course more than are regularly required of sophomores. Such a plan of study would be considered rather severe even for a student with no outside work.

TABLE 5.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 403.*

SUBJECT C.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beef hash (20), 1, 7 cents; pork, bacon (with eggs) (39), 1, 4 cents. Total meats, etc	0.5	1.3	25	1.3	22
Purée of peas (58), 3, 9 cents; soup (59), 1, 3 cents. Total soups	.6	1.3	31	1.3	27
Eggs, fried (with bacon) (78), 1, 8 cents; fried (78), 1,[a] 4 cents; egg omelet (81), 1, 10 cents; eggs, scrambled (84), 1, 10 cents. Total eggs, etc	1.5	3.7	76	3.6	68
Butter (87), 22, 22 cents; milk, glass (95), 33, 66 cents; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products	4.3	10.8	332	10.5	309
Prepared cereals (97), 1, 4 cents; oatmeal, (103), 2, 8 cents; shredded wheat (109), 5, 20 cents. Total breakfast cereals	1.5	2.5	87	2.1	79
Bread, Graham (116), 55, 55 cents; bread, corn (119), 11, 11 cents; rolls (131), 4, 4 cents; griddlecakes (147), 1, 5 cents; macaroni (155), 2, 14 cents. Total bread, crackers, etc	4.2	19.9	643	16.9	585
Gingerbread (168), 1, 1 cent; pie (172), 1, 5 cents; coffee jelly (185), 1, 4 cents; ice cream (182), 1, 7 cents. Total desserts, etc	.8	.7	50	.6	47
Beans, baked (189), 2, 8 cents; beans, Lima (192), 3, 9 cents; celery (222), 2, 10 cents; potatoes, baked (199), 4, 8 cents; potatoes, hashed (214), 1, 2 cents; sweet potatoes (216), 9, 18 cents; succotash (230), 1, 3 cents. Total vegetables	2.8	6.1	266	5.1	242
Oranges (252), 1, 3 cents	.1	.1	4	.1	4
Sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 43, 0.[b] Total sugars, etc	.1	....	83	....	81
Coffee (263), 17, 51 cents	2.4	.1	25	.1	25
Combination breakfasts (268), 13, $1.30; lunches (271), 18, $1.80; dinners (274), 11, $1.32. Total combination meals	21.1	55.5	1,622	51.1	1,492
Total food	39.9	102.0	3,244	92.7	2,981
Period 2, 3 weeks, February 14 to March 6.					
Beef stew (9), 1, 10 cents; beef hash (21), 3, 21 cents; pork, bacon (with eggs) (40), 1, 4 cents. Total meats, etc	1.7	7.1	91	6.9	79
Eggs (with bacon) (79), 1, 8 cents; eggs, scrambled (85), 1, 10 cents. Total eggs, etc	.9	2.2	47	2.1	42
Butter (88), 33, 33 cents; milk, glass (95), 8, 16 cents; milk, 4-ounce pitchers (96), 13, 13 cents. Total dairy products	2.9	4.9	251	4.8	233
Oatmeal (104), 4, 12 cents; rice (107), 1, 3 cents; shredded wheat (109), 5, 20 cents. Total breakfast cereals	1.7	2.5	88	2.1	80
Bread, white (114), 9, 9 cents; bread, Graham (117), 54, 54 cents; bread, corn (120), 10, 10 cents; biscuit (126), 1, 1 cent; rolls (132), 2, 2 cents; scones (142), 1, 1 cent. Total bread, crackers, etc	3.7	21.3	694	18.1	632
Gingerbread (169), 5, 5 cents; eclairs (167), 1, 4 cents; pie (173), 3, 15 cents; coffee jelly (186), 10, 40 cents. Total desserts, etc	3.0	3.3	177	2.8	165
Beans, baked (190), 2, 8 cents; beans, Lima (193), 1, 3 cents; peas (196), 3, 9 cents; potatoes, baked (200), 5, 10 cents; sweet potatoes (217), 16, 32 cents; cabbage (220), 2, 6 cents; corn, stewed (224), 4, 12 cents; pickles (238), 5, 5 cents; spinach (229), 1, 2 cents. Total vegetables	4.1	8.4	401	7.0	365
Bananas (243), 5, 10 cents; oranges (250), 7, 21 cents. Total fruits	1.5	.9	64	.8	56
Sugar, teaspoonfuls (259), 57, 0 [b]	....	....	96	....	94
Cereal coffee (264), 2, 6 cents; cocoa (262), 2, 6 cents; coffee (263), 27, 81 cents. Total beverages	4.4	2.1	47	2.0	46
Combination breakfasts (269), 11, $1.10; lunches (272), 16, $1.60; dinners (275), 8, 96 cents. Total combination meals	17.4	48.9	1,440	45.0	1,325
Total food	41.3	101.6	3,396	91.6	3,117

[a] Order for one-half the usual amount.

[b] See footnote *r* to Table 1.

TABLE 5.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 403*—Continued.

SUBJECT C—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beef, roast (8), 5, 50 cents; beef stew (9), 1, 10 cents; beef hash (22), 3, 18 cents; beef, corned (4), 2, 16 cents; hash of ham and eggs (47), 1, 10 cents. Total meats, etc	5.0	18.0	229	17.5	199
Purée of peas (58), 3, 9 cents; soup (61), 2, 6 cents. Total soups, etc	.7	1.7	34	1.6	29
Eggs, scrambled (86), 1, 8 cents; eggs, dropped (77), 1, 6 cents. Total eggs	.7	2.6	52	2.5	46
Cream (with strawberries) (93), 1, 0;[a] milk, glass (95), 5, 10 cents; milk, 4-ounce pitchers (96), 10, 10 cents; butter (89), 38, 38 cents. Total dairy products	2.7	3.5	261	3.4	243
Prepared cereals (99), 1, 4 cents; oatmeal (105), 1, 3 cents; wheat (111), 7, 21 cents. Total breakfast cereals	1.3	2.3	79	2.0	72
Bread, white (115), 1, 1 cent; bread, Graham (118), 60, 60 cents; bread, corn (121), 8, 8 cents; griddle-cakes (146), 2, 8 cents; macaroni (156), 2, 12 cents; scones (142), 3, 3 cents. Total bread, crackers, etc.	4.4	21.0	684	17.9	622
Cookies (163), 2, 2 cents; cake (160), 6, 6 cents; pie (174), 6, 24 cents; pudding (177), 2, 8 cents; shortcake, crust (180), 2, 0;[a] shortcake, strawberries (179), 2, 15 cents; coffee jelly (187), 1, 4 cents; ice cream (184), 3, 21 cents. Total desserts, etc	3.8	5.0	315	4.3	293
Beans, Lima (194), 5, 10 cents; beans, wax (195), 1, 2 cents; beans, baked (191), 1, 4 cents; cabbage (221), 3, 6 cents; corn (225), 6, 12 cents; peas (197), 1, 2 cents; pickles (239), 2, 2 cents; potatoes, stewed (206), 1, 2 cents; potatoes, baked (201), 4, 8 cents; potatoes, mashed (205), 6, 12 cents; radishes (228), 1, 4 cents; succotash (231), 5, 10 cents; tomatoes (233), 1, 2 cents; turnips (235), 1, 2 cents. Total vegetables, etc	3.7	6.3	209	5.2	190
Apples (240), 3, 6 cents; bananas (244), 7, 14 cents; oranges (251), 17, 51 cents; strawberries (256), 2, 15 cents. Total fruits	4.1	1.7	116	1.4	102
Sugar, teaspoonfuls (259), 54, 0;[a] sirup (260), 2, 4 cents. Total sugar, etc	.2	....	111	....	109
Coffee (263), 25, 75 cents; birch beer (266), 1, 5 cents; ginger ale (266), 2, 10 cents; lemonade (267), 7, 14 cents; sarsaparilla (266), 1, 5 cents. Total beverages	5.2	1.8	87	1.7	85
Combination breakfasts (270), 7, 70 cents; lunches (273), 16, $1.60; dinners (276), 2, 24 cents. Total combination meals	12.1	23.3	819	21.4	753
Total food	43.9	87.2	2,948	78.9	2,743
Average of three periods	41.7	96.9	3,196	87.7	2,947

[a] See footnote *r* to Table 1.

The average amount of digestible protein furnished by the diet selected by the subject is not far from the quantity called for by the standard selected for comparison, whereas in general the amount of energy was somewhat higher than the standard called for. About 54 per cent of the total digestible protein and 34 per cent of the available energy in the average diet of Subject C came from animal food. It is noticeable that nearly 40 per cent of the nutrients in the average ration for the three periods was furnished by the combination meals. In other words, he lived half on foods which he selected and half on meals selected by the commons management. The use of many combination meals explains the fact that a number of important classes of food appear in quantities considerably below the average. For example, separate orders of meats and cereals were eaten in about one-half the average amounts, and dairy products, eggs, and breads in about 65 per cent of the average amounts. Besides combination meals, the only articles chosen in quantities greater than the average for the ten men studied were vegetables and beverages (chiefly coffee), both of which were about 20 per cent above the average. On the basis of economy so much coffee was not a wise selection, since its value as a source of nutrients and energy is very small in proportion to the cost and due chiefly to the milk and sugar which are added to it. In this dietary, therefore, about 9.5 per cent of the total sum was expended for articles yielding only about 1.5 per cent of the total digestible protein and available energy. This is noteworthy when it is remembered that 9.9 per cent of the total outlay was for breadstuffs, which yielded 20 per cent of the total protein and energy.

For the first two periods, fall and winter, the rations were more abundant than later, furnishing on an average 92.1 grams of digestible protein and 3,049 calories of available energy, or 100 per cent and 113 per cent, respectively, of the values called for by the standard selected for comparison. In period 3, however, the protein dropped to 78.9 grams and the energy to 2,743 calories (86 and 101 per cent, respectively, of the standard), while the cost increased to 43.9 cents, or about 8.5 per cent more than the average for the first two periods. It is evident that, as compared with the subjects already noted, Subject C was not getting a large return for his investment. He might have secured the same amount of protein and energy if he had selected a larger proportion of foods similar to those chosen by Subjects A and B.

The chief reason for the sudden drop in the nutritive value of the ration of Subject C, in spite of the higher daily cost, is undoubtedly to be found in the tendency to use meats and fruits—both relatively expensive foods at Randall Hall—in place of combination meals. It should be noted that in period 3 he obtained in 1 cent's worth of vegetables only about 0.8 of the protein and 0.6 of the energy that 1 cent's worth of vegetables furnished in periods 1 and 2. Similarly, for the same sum, the combination meals yielded only 0.7 to 0.8 as much as in periods 1 and 2. Of the two conceivable causes of this condition (higher relative cost and less wise choice of dishes during period 3), it seems probable that higher cost was responsible for the lower value per money unit of the combination meals and that a more liberal use of green spring vegetables was responsible for the lower value of vegetables per money unit. In some measure, then, it appears that the ration of Subject C during period 3 must necessarily have been lower per money unit because the scale of prices had changed, and, consequently, no redistribution of the cost items would bring exactly the same value as was secured in periods 1 and 2 for the same sum.

At the end of the study Subject C weighed 143 pounds, or 2 pounds less than at the beginning of the investigation, some seven months previous. The anthropometric measurements showed very small changes, but, as shown by the strength tests, the subject gained rather more than the average, indicating a slight improvement in muscular condition. Medical examination showed no marked change in his general physical condition.

In his college work Subject C attained a grade between B and C, which may be considered slightly above the average. Remembering that he carried 6 courses, instead of the usual 4½, and that he supported himself by outside work, his performance was very creditable indeed.

The general average for the three periods shows 87.7 grams of digestible protein and 2,947 calories of available energy in the daily food. Although these figures are lower than they would have been if he had exercised the same prudence in the selection of economical dishes in the last period as he did in the first two periods, they are not very far from the commonly accepted standard for a man of sedentary habits, namely, 92 grams of digestible protein and 2,700 calories of available energy. It is not at all certain, however, that for a person of such active habits and long hours of duty the diet was in every way sufficient for the best functioning of brain and body. It is to be observed that, although Subject C had been seriously ill shortly before the beginning of the college year, his bodily weight was less at the end of the study than at the beginning, whereas the average gain of the 10 men studied was 4 per cent over their initial weights.

DIETARY STUDY NO. 404.

Subject D was 22 years old, 5 feet 6.5 inches in height, and weighed 119.5 pounds. In the usual physical examination he was classed as poorly developed and nourished. His bodily measurements, as well as his height, were considerably below the average for men of the same age.

A sophomore in the college, he devoted himself exclusively to mathematics and physics, carrying the usual 4 courses, of which one was on the subject of physics. He slept 6½ to 7¼ hours per day. Of all the men studied, he devoted the greatest number of hours to his college work, the time thus spent amounting to 11½ to 12¾ hours, or virtually the whole working day. He did no work outside of his college course and took practically no exercise, the sum total for the entire three periods amounting to only 30 minutes to 1 hour gymnasium work per day on 9 days.

TABLE 6.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 404.*

SUBJECT D.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beefsteak (10), 8, 80 cents; pork, broiled ham (with eggs) (49), 2, 20 cents; ham cakes (44), 1, 10 cents. Total meats, etc	5.2	15.0	176	14.6	153
Oysters, fried (69), 1, 25 cents; oyster pie (73), 1, 12 cents; sea trout, fried (66), 1, 10 cents. Total fish, etc	2.2	3.6	47	3.5	40
Eggs (with ham) (78), 2, 16 cents	.8	1.1	22	1.1	20
Butter (87), 103, $1.03; milk, glass (95), 40, 80 cents; milk, 4-ounce pitchers (96), 19, 19 cents; cream (92), 1, 2 cents. Total dairy products	9.7	16.4	814	15.9	757
Hominy (100), 11, 44 cents; oatmeal (103), 1, 4 cents; rice (106), 8, 32 cents. Total breakfast cereals, etc.	3.8	3.7	166	3.1	151
Bread, white (113), 1, 1 cent; biscuit (125), 2, 2 cents; rolls (131), 36, 36 cents; toast, buttered (137), 21, 63 cents; buckwheat cakes (143), 3, 15 cents; griddlecakes (147), 5, 25 cents. Total breads, crackers, etc	6.7	19.1	706	16.2	642
Coffee jelly (185), 1, 4 cents; cake (158), 2, 2 cents; doughnuts (164), 2, 2 cents; ice cream (182), 2, 14 cents; pudding (175), 3, 15 cents. Total desserts, etc	1.8	2.1	117	1.8	109
Corn (223), 1, 3 cents; potatoes, baked (199), 7, 14 cents; potatoes, lyonnaise (211), 19, 95 cents; sweet potatoes (216), 6, 12 cents. Total vegetables	5.9	5.6	314	4.7	313
Apples, baked (241), 1, 4 cents; bananas (245), 20, 40 cents; oranges (252), 4, 12 cents. Total fruits	2.7	1.5	114	1.3	100
Sugar, teaspoonfuls (259), 50, 0;[a] sirup (260), 8, 16 cents. Total sugars, etc	.8	....	164	....	161
Coffee (263), 3, 9 cents; cocoa (262), 1, 3 cents. Total beverages	.6	.3	7	.3	7
Combination lunches (271), 1, 10 cents; dinners (274), 1, 12 cents. Total combination meals	1.0	2.8	80	2.6	74
Total food	41.2	71.2	2,757	65.1	2,527
Period 2, 3 weeks, February 14 to March 6.					
Beef, boiled (1), 1, 10 cents; beefsteak (11), 5, 50 cents; rump steak (14), 3, 60 cents; pork sausage (50), 1, 8 cents; chicken pie (51), 1, 12 cents. Total meats, etc	6.7	19.7	242	19.1	211
Oysters, raw, ½ dozen (68), 2, 20[b] cents; scallops, fried (74), 1, 10 cents; fish balls (76), 1, 5 cents. Total fish, etc	1.7	2.8	28	2.7	24
Soups (60), 1, 3 cents	.1	.2	3	.2	3
Butter (88), 94, 94 cents; cream (92), 28, 56 cents; milk, glass (95), 12, 24 cents; milk, 4-ounce pitchers (96), 15, 15 cents. Total dairy products	9.0	9.0	738	7.7	686
Hominy (101), 12, 36 cents; rice (107), 3, 9 cents; shredded wheat (109), 14, 56 cents. Total breakfast cereals, etc	4.8	6.4	268	5.4	241
Rolls (132), 26, 26 cents; toast, buttered (135), 13, 39 cents; buckwheat cakes (144), 2, 10 cents; griddlecakes (145), 6, 30 cents; crackers (153), 1, 1 cent. Total bread, crackers, etc	5.1	14.0	508	11.9	462
Cake (159), 3, 3 cents; puddings (176), 2, 8 cents; sherbet (188), 1, 6 cents. Total desserts, etc	.8	1.1	57	.9	53
Potatoes, baked (200), 2, 4 cents; potatoes, boiled (202), 1, 2 cents; potatoes, French fried (209), 9, 45 cents; potatoes, mashed (204), 1, 2 cents; potato salad (215), 1, 5 cents; sweet potatoes (217), 19, 38 cents; corn, stewed (224), 1, 3 cents. Total vegetables	4.7	7.2	470	6.0	428
Apples, baked (241), 1, 4 cents; bananas (243), 13, 26 cents; grapes (248), 1, 5 cents; oranges (250), 9, 27 cents; peaches, canned (253), 1, 4 cents. Total fruits	3.1	1.5	113	1.3	99

[a] See footnote *r* to Table 1.

[b] Oysters, raw, 15 cents per dozen; 10 cents per half dozen.

TABLE 6.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 404*—Continued.

SUBJECT D—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 2, 3 weeks, February 14 to March 6—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Sirup (260), 8, 16 cents; sugar (259), 112, 0.[a] Total sugars, etc	0.8	....	258	....	253
Chocolate (265), 21, $1.05; coffee (263), 2, 6 cents. Total beverages	5.3	4.0	135	3.9	132
Total food	42.1	65.9	2,820	59.1	2,595
Period 3, 3 weeks, May 8 to May 28.					
Beefsteak (12), 5, 50 cents; pork, ham cake (44), 2, 20 cents. Total meats, etc	3.3	12.1	159	11.7	138
Soups (61), 2, 6 cents	.3	.6	9	.6	8
Bass, fried (62), 1, 10 cents; mackerel (64), 4, 40 cents; shrimp salad (75), 1, 15 cents; trout, baked (66), 1, 10 cents. Total fish, etc	3.6	9.2	73	8.9	62
Eggs, scrambled (86), 2, 16 cents	.8	4.1	87	4.0	77
Butter (89), 75, 75 cents; cream (92), 13,[b] 84 cents; milk, glass (95), 1, 2 cents; milk, 4-ounce pitchers (96), 4, 4 cents. Total dairy products	7.8	4.8	659	4.7	613
Hominy (102), 10, 30 cents; rice (108), 2, 6 cents; shredded wheat (109), 34,[c] 68 cents. Total breakfast cereals, etc	4.9	6.7	275	5.7	250
Biscuit (127), 1, 1 cent; rolls (133), 38, 38 cents; toast, buttered (136), 12, 36 cents; griddlecakes (146), 5, 20 cents; crackers for soup (154), 2, 2 cents. Total breads, crackers, etc	4.6	16.3	586	13.9	533
Cake (160), 3, 3 cents; doughnuts (166), 1, 1 cent; puddings (177), 1, 4 cents; coffee jelly (187), 4, 16 cents; ice cream (184), 2, 14 cents; sherbet (188), 1, 6 cents. Total desserts, etc	2.1	1.8	103	1.5	96
Peas (197), 1, 2 cents; potatoes, baked (201), 5, 10 cents; potatoes, boiled (202), 5, 10 cents; potatoes, griddled (210), 1, 10 cents; potatoes, French fried (209), 10, 50 cents; potatoes, lyonnaise (212), 5, 25 cents; corn (225), 2, 4 cents; radishes (228), 2, 8 cents; tomatoes (233), 1, 2 cents. Total vegetables	5.8	4.7	246	3.9	224
Bananas (244), 6, 12 cents; oranges (251), 1, 3 cents; peaches, canned (253), 7, 28 cents; strawberries (256), 3, 26 cents. Total fruits, etc	3.3	.7	49	.6	43
Honey (261), 1, 4 cents; sirup (260), 5, 10 cents; sugar, teaspoonfuls (259), 192, 0.[a] Total sugars, etc	.7	....	386	....	378
Chocolate (265), 19, 95 cents; coffee (263), 19, 57 cents; lemonade (267), 2, 4 cents. Total beverages	7.4	4.8	157	4.7	154
Total food	44.6	65.8	2,789	60.2	2,576
Average for three periods	42.7	67.6	2,789	61.5	2,566

[a] See footnote *r* to Table 1.

[b] Includes one order of cream, served with strawberries, for which there was no charge.

[c] Orders for one-half the usual amount.

In the dietary of this subject the unusually small amounts of protein and energy in the total food eaten per diem, the high comparative cost of the diet, and the small number of combination meals are noticeable. Thus for the three periods the digestible protein averages 61.5 grams and the available energy 2,566 calories, or 67 and 95 per cent, respectively, of amounts called for by the commonly accepted standard for a man of sedentary occupation. Though low in nutritive value, this ration cost 42.7 cents per day.

The protein from animal foods amounted to about 54.5 per cent and the energy to about 38 per cent of the total.

It is easy to suggest changes whereby the value of the ration might have been increased without increasing the cost. The amount spent for meats, beverages, and cereals is about 35 per cent, that for vegetables about 80 per cent, and for fruits about 25 per cent higher than the average for the ten men studied. In the case of cereals this increase was profitable, since they are economical foods at the Randall Hall prices, but, as noted before, meats are an expensive source of nutrients, while beverages and fruits yield very little protein and energy. Thus for an expenditure of about 7.4 cents, or 17 per cent of the total cost of the diet, the fruits and beverages together furnished only about 6.5 per cent of the total digestible protein and about 7 per cent of the total available energy, whereas the same sum expended for breadstuffs would have increased the diet by nearly one-quarter of the total nutrients involved. A further economy could have been brought about by devoting part of the sum expended for meat, especially during period 2, to combination meals and by using cheaper meat foods, such as beef stew, beef potpie, meat croquettes, and hash, in place of rump steak, sausage, ham cakes, and various sorts of fish. In the class of vegetable foods not only was the amount spent 80 per cent higher than the average, but the quantities of protein and energy procured per unit of money were less. A smaller expenditure for vegetables and the selection of baked beans, baked or hashed brown potatoes, and sweet potatoes in place of the more expensive potato salad, French fried and lyonnaise potatoes would have been more economical. In the case of breads the quantities of digestible protein and available energy obtained for 1 cent amounted to but 65 and 70 per cent, respectively, of the average amounts obtained by the ten subjects. The quite general use of toast and griddlecakes in place of the more economical white bread was the probable cause of this condition, which affects the value of the ration very materially, since breadstuffs furnished over 20 per cent of the total nutrients. The quantity of protein furnished by the dairy products per money unit dropped in period 2 to 60 per cent, and in period 3 to a little over 35 per cent of that in period 1, owing to a decrease in the amount of milk used and an increase in the amount of cream.

The weight of Subject D, at the end of the investigation, was 120.5 pounds, showing a gain of 1 pound in about six months. Such a difference might easily have been occasioned by the daily fluctuation in intestinal contents, etc., so we may infer that the weight was practically constant throughout the college year. Examination showed that his general physical condition, which was rather below par at the outset, had not changed. Anthropometric measurements also disclosed no changes.

The standing of Subject D in his studies was creditable. His courses may be fairly said to provide a moderately hard year's work, yet he passed with an average grade of B.

In general it may be said that this subject, whose diet contained but 67 per cent of the protein and 95 per cent of the energy called for by the standard selected for comparison, did his work well throughout the year, and showed neither loss of weight nor any physical deterioration that could be detected by careful medical examination. The unusually small quantity of protein in the daily ration brings up the question whether he was really in nitrogen equilibrium or whether he was losing nitrogen and replacing it by fatty tissue or water. It would, therefore, have been especially interesting had opportunity offered to determine the outgo of nitrogen in order to test the question.

DIETARY STUDY NO. 405.

Subject E was 26 years old, 5 feet 5.5 inches in height, and weighed 136.3 pounds. Although small of stature, his measurements in other respects were not far from the general run of men of the same age. Examination showed that he was in fair physical condition and fairly well nourished.

He was a senior in the Lawrence Scientific School and carried about seven courses, most of which pertained to engineering. The university work was, perhaps, no more difficult than that of many scientific students in their senior year.

He spent daily 7¾ to 8 hours in sleep, 6½ to 9½ hours in college work, and had no outside work. His exercise consisted in walking two or three miles per day.

TABLE 7.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 405.*

SUBJECT E.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beef hash (20), 3, 21 cents; beefsteak pie (25), 1, 10 cents; lamb, roast (32), 3, 30 cents; venison potpie (30), 1, 10 cents; lamb croquettes (37), 1, 10 cents; turkey and sauce (54), 4, 60 cents. Total meats, etc.	6.7	21.5	284	20.9	247
Chowder (57), 5, 15 cents; purée of peas (58), 3, 9 cents; soup (59), 5, 15 cents. Total soups, etc......	1.9	3.9	77	3.8	66
Oysters, raw (68), 3, 45 cents; oyster pie (73), 1, 12 cents. Total fish, etc..................................	2.7	3.5	50	3.4	43
Eggs, raw (77), 2, 16 cents; omelet (81), 2, 20 cents. Total eggs, etc..................................	1.7	3.1	52	3.0	46
Butter (87). 41, 41 cents; milk, bowl (94), 4,[a] 18 cents; milk, glass (95), 49, 98 cents; milk, 4-ounce pitchers (96), 6, 6 cents. Total dairy products..............	7.8	18.9	591	18.3	550

[a] Includes two orders of hot milk.

TABLE 7.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 405*—Continued.

SUBJECT E—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20—Cont'd.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Prepared cereal (97), 2, 8 cents; rice (106), 2, 8 cents; shredded wheat (109), 2, 8 cents. Total breakfast cereals	1.1	1.0	65	0.9	59
Bread, white (113), 63, 63 cents; bread, Graham, (116), 1, 1 cent; bread, corn (119), 12, 12 cents; biscuit (125), 1, 1 cent; gems, Graham (130), 5, 5 cents; rolls (131), 12, 12 cents; toast, creamed (138), 1, 7 cents. Total breads, crackers, etc	4.8	23.8	765	20.2	696
Cake, cream (158), 1, 4 cents; pie, apple (172), 4, 20 cents; pudding, tapioca (175), 3, 15 cents. Total desserts	1.9	2.7	160	2.3	149
Beans, baked (189), 1, 4 cents; sweet potatoes (216), 6, 12 cents; celery (222), 3, 15 cents; onions, boiled (227), 6, 18 cents. Total vegetables	2.3	2.8	140	2.3	127
Apples (240), 16, 32 cents; oranges (252), 3, 9 cents; sauce, cranberry (258), 2, 8 cents. Total fruits	2.3	.5	66	.4	58
Sugar (259), 98, 0[a]			166		163
Combination breakfasts (268), 8, 80 cents; lunches (271), 4, 40 cents; dinners (274), 6, 72 cents. Total combination meals	9.2	24.2	664	22.3	611
Total food	42.4	105.9	3,080	97.8	2,815
Period 2, 3 weeks, February 14 to March 6.					
Veal, roast (with dressing) (28), 1, 10 cents; dressing (with veal) (29), 1, 0[a]; lamb, roast (33), 4, 40 cents; turkey, roast (55), 2, 30 cents. Total meats, etc	3.8	12.2	123	11.8	107
Chowder (57). 2, 6 cents; purée of peas (58), 1, 3 cents; soup (60), 3, 9 cents. Total soups, etc	.9	1.5	29	1.5	25
Lobster (67), 2, 50 cents; oyster stew (71), 1, 10 cents; fishballs (76), 2, 10 cents. Total fish, etc	3.3	4.0	47	3.9	40
Eggs (with toast) (77), 1, 8 cents; egg omelet (82), 9, 90 cents. Total eggs, etc	4.7	10.5	203	10.2	181
Butter (88), 24, 24 cents; milk, glass (95), 71, $1.42; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products	8.0	22.7	599	22.0	557
Prepared cereal (98), 1, 4 cents; rice (107), 1, 3 cents. Total breakfast cereals	.3	.5	18	.4	16
Bread, white (114), 37, 37 cents; bread, Graham (117), 4, 4 cents; bread, corn (120), 11, 11 cents; biscuit (126), 1, 1 cent; gems, Graham (128), 4, 4 cents; rolls (132), 14, 14 cents; toast (134), 2, 4 cents; toast, creamed (138), 1, 7 cents; toast (with eggs) (140), 1, 2 cents; macaroni (157), 1, 7 cents. Total breads, crackers, etc	4.3	18.8	609	16.0	554
Puddings (176), 2, 9 cents	.4	.7	28	.6	26
Beans, baked (190), 2, 8 cents; sweet potatoes (217), 10, 20 cents; onions, boiled (227), 6, 18 cents. Total vegetables	2.2	4.7	228	3.9	207
Apples (240), 19, 38 cents; bananas (243), 6, 12 cents; grapes (248), 2, 10 cents; oranges (250), 12, 36 cents; sauce, cranberry (258), 1, 4 cents. Total fruits	4.8	1.7	149	1.4	131
Sugar, teaspoonfuls (259), 16, 0[a]			27		27
Combination breakfasts (269), 6, 60 cents; lunches (272), 9, 90 cents; dinners (275), 8, 96 cents. Total combination meals	11.7	32.3	921	29.7	847
Total food	44.4	109.6	2,981	101.4	2,718
Period 3, 3 weeks, May 8 to May 28.					
Turkey, roast, and dressing (56), 6, 90 cents	4.3	17.2	158	16.7	137
Purée of peas (58), 1, 3 cents; soup (61), 2, 6 cents. Total soups, etc	.4	1.0	17	1.0	15
Shrimp salad (75), 1, 15 cents	.7	2.2	13	2.1	11
Eggs, dropped (77), 2,[b] 6 cents; egg omelet (83), 4, 32 cents. Total eggs, etc	1.8	4.3	81	4.2	72
Butter (89), 32, 32 cents; cream (with strawberries) (93), 3, 0[a]; milk, glass (95), 91, $1.82; milk, 4-ounce pitchers (96), 5, 5 cents. Total dairy products	10.4	29.7	807	28.8	751

[a] See footnote *r* to Table 1.

[b] Orders for one-half the usual amount.

TABLE 7.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 405*—Continued.

SUBJECT E—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Oatmeal (105), 3, 9 cents; rice (108), 1, 3 cents; shredded wheat (109), 1, [a]2 cents; wheat (111), 1, 3 cents. Total breakfast cereals	0.8	1.5	48	1.3	44
Bread, white (115), 45, 45 cents; bread, corn (121), 5, 5 cents; gems, Graham (129) 9, 9 cents; rolls (133), 18, 18 cents; toast (134), 1, 2 cents; toast (with asparagus) (141), 3, 0[b]; macaroni (156), 1, 6 cents. Total breads, etc	4.0	21.0	675	17.9	614
Cake (160), 3, 3 cents; pie (174), 1, 4 cents; pudding (177), 3, 12 cents; tarts (181), 1, 2 cents; ice cream (184), 1, 7 cents. Total desserts	1.3	2.0	113	1.7	105
Peas (197), 2, 4 cents; potatoes, mashed (205), 4, 8 cents; asparagus (with toast) (218), 3, 24 cents; corn (225), 1, 2 cents; onions (227), 5, 15 cents; spinach (229), 3, 6 cents; succotash (231), 4, 8 cents; tomatoes (233), 2, 4 cents. Total vegetables	3.4	2.6	83	2.2	76
Apples (240), 6, 12 cents; oranges (251), 7, 21 cents; prunes, stewed (255), 3, 12 cents; strawberries (256), 3, 25 cents; preserves (257), 16, 64 cents; sauces (258), 3, 12 cents. Total fruits, etc	7.0	1.2	205	1.0	180
Sugar, teaspoonfuls (259), 26, 0[b]	....	....	44	....	43
Lemonade (267), 2, 4 cents	.2	....	9	....	9
Combination breakfasts (270), 5, 50 cents; lunches (273), 12, $1.20; dinners (276), 1, 12 cents. Total combination meals	8.7	16.6	592	15.3	545
Total food	43.0	99.3	2,845	92.2	2,602
Average for three periods	43.3	104.9	2,969	97.1	2,712

[a] Order for one-half the usual amount.

[b] See footnote *r* to Table 1.

The amounts of digestible protein and available energy per diem for all three periods averaged 97.1 grams protein and 2,712 calories, or practically the quantities called for by the commonly accepted standard for a man of sedentary occupation. In this study 67 per cent of the digestible protein came from animal sources.

The average cost of the ration was 43.3 cents per day. Of this about 10 per cent was expended for fruits, yielding only 1 per cent of the total protein and 4.5 per cent of the total energy, whereas the sum expended for breads, also 10 per cent of the total, supplied about 20 per cent of the total protein and energy. It is not to be inferred that fruit should not be used; the purpose of the above comparison is simply to emphasize the economy of minimizing as far as possible the expenditure for foods that contain little nourishment per money unit without destroying the palatability of the ration. On foods relatively rich in protein (meats, eggs, and dairy products) Subject E spent from 30 to 60 per cent more than the average of the 10 men studied, which accounts for the relatively high proportion of protein and energy derived from animal foods. The expenditure for vegetable foods is of course correspondingly low; thus his expenditure for cereals was only 20 per cent, that for desserts 50 per cent, breads 70 per cent and for vegetables 80 per cent, of the average amounts spent by the ten subjects for such materials. It is to be noticed that he used considerable sugar (for which no charge is made) and got along practically without beverages (tea, coffee, and cocoa), thereby effecting a considerable saving. As regards dairy products, the quantity of protein bought for 1 cent is about 35 per cent higher than the average for the ten men, and that of energy about equal to the average.

At the end of the investigation Subject E had gained 3.7 pounds in weight and showed a corresponding slight increase in his anthropometric measurements. No change in his general physical condition was noted.

In the examinations at the end of the academic year he passed in all his studies with an average grade a little below B, a very creditable performance considering the fact that he carried seven courses.

In general, it may be said that Subject E accomplished a satisfactory year's work, chiefly intellectual in nature, on a diet which averaged for the three test periods almost exactly the amounts of protein and energy required by a commonly accepted standard for a man of sedentary occupation, and maintained his general health and physical condition.

DIETARY STUDY NO. 406.

Subject F was 25 years old, 5 feet 3.8 inches in height, and weighed 120.2 pounds. He was a small man but tolerably well proportioned. Like the majority of the men included in this investigation he was in fair physical condition. His daily programme differs from most of the others in that he spent rather less time on college work and slept longer, devoting 7 to 7½ hours daily to college duties and 8 to 8½ hours to sleep. He did no outside work. During the fall and winter periods he walked or took gymnasium exercises 30 minutes to 1 hour daily. During the three weeks covered by the spring period he walked or played handball three-fourths to 1½ hours per day for seven days.

Subject F was a second-year student in the graduate school, and carried the equivalent of four full courses about equally divided between the classical languages and philology.

Table 8.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 406.*

SUBJECT F.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beef croquettes (18), 2, 20 cents; beef hash (20), 1, 7 cents; roast turkey and sauce (54), 2, 30 cents. Total meats	2.7	13.1	128	12.7	111
Purée of peas (58), 1, 3 cents; soup (59), 1, 3 cents. Total soups, etc	.3	.6	13	.6	11
Egg omelet (81), 2, 20 cents	.9	1.9	36	1.8	32
Butter (87), 57, 57 cents; cheese, sage (91), 1, 1 cent; milk, glass (95), 1, 2 cents; milk, bowl (94), 1, 4 cents; milk, 4-ounce pitchers (96), 1, 1 cent. Total dairy products	3.1	1.6	285	1.6	265
Rice (106), 1, 4 cents	.2	.2	8	.2	7
Bread, white (113), 60, 60 cents; bread, Graham (116), 70, 70 cents; crackers for soup (152), 2, 2 cents; macaroni (155), 1, 7 cents. Total bread, crackers, etc	6.6	37.9	1,208	32.2	1,099
Cookies (161), 4, 4 cents; gingerbread (168), 4, 4 cents; cake (158), 13, 13 cents; pie (172), 1, 5 cents; tarts (181), 2, 4 cents; puddings (175), 2, 7 cents. Total desserts, etc	1.8	4.1	250	3.5	232
Beans, baked (189), 3, 12 cents; sweet potatoes (216), 4, 8 cents; turnips (235), 1, 3 cents. Total vegetables	1.1	3.6	125	3.0	114
Bananas (245), 3, 6 cents; preserves, pineapple (257), 1, 4 cents. Total fruits, etc	.5	.2	23	.2	20
Sugar, teaspoonfuls (259), 132, 0[a]	....	....	223	....	219
Coffee (263), 21, 63 cents; cocoa (262), 27, 81 cents. Total beverages	6.9	4.1	105	4.0	103
Combination lunches (271), 8, 80 cents; dinners (274), 10, $1.20. Total combination meals	9.5	25.3	712	23.3	655
Total food	33.6	92.6	3,116	83.1	2,868
Period 2, 3 weeks, February 19 to March 11.					
Beefsteak (11), 1, 10 cents; pork, fried ham (45), 1, 10 cents. Total meats, etc	1.0	2.6	33	2.5	29
Purée of peas (58), 1, 3 cents	.1	.4	9	.4	8
Butter (88), 15, 15 cents; cheese (90), 3, 3 cents; milk, glass (95), 17, 34 cents; milk, bowl (94), 4, 16 cents. Total dairy products	3.2	8.5	247	8.2	230
Bread, white (114), 32, 32 cents; bread, Graham (117), 32, 32 cents; bread, corn (120), 15, 15 cents; biscuits (126), 3, 3 cents; rolls (132), 14, 14 cents; crackers (153), 1, 1 cent; crackers, Graham (149), 1, 3 cents. Total bread, crackers, etc	4.8	24.9	823	21.2	749
Cake (159), 25, 25 cents; cookies (162), 11, 11 cents; tarts, damson (181), 4, 8 cents. Total desserts, etc.	2.1	5.1	322	4.3	299
Potatoes, baked (200), 1, 2 cents; sweet potatoes (217), 2, 4 cents; onions, raw (226), 1, 3 cents. Total vegetables	.4	.7	46	.6	42
Figs, dried (249), 2, 8 cents	.4	.3	27	.3	24
Sugar, teaspoonfuls (259), 144, 0[a]	....	....	244	....	239
Cereal coffee (264), 1, 3 cents; cocoa (262), 29, 87 cents; coffee (263), 8, 24 cents. Total beverages	5.4	2.8	79	2.7	77
Combination breakfasts (269), 17, $1.70; lunches (272), 12, $1.20; dinners (275), 7, 84 cents. Total combination meals	17.8	48.5	1,444	44.6	1,328
Total food	35.2	93.8	3,274	84.8	3,025
Period 3, 3 weeks, May 8 to May 28.					
Beef, Hamburg steak (13), 1, 10 cents; pork, bacon (with eggs) (41), 1, 4 cents. Total meats, etc	.7	2.1	26	2.0	23
Eggs (with bacon), (80), 1, 6 cents; egg omelet (83), 1, 8 cents. Total eggs, etc	.7	1.4	28	1.4	25
Butter (89), 19, 19 cents; cream (for strawberries) (93), 1, 0[a]; milk, bowl (94), 2, 8 cents; milk, glass (95), 12, 24 cents; milk, 4-ounce pitchers (96), 1, 1 cent. Total dairy products	2.5	5.7	208	5.5	193

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[a] See footnote *r* to Table 1.

TABLE 8.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 406*—Continued.

SUBJECT F—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Bread, white (115) 49, 49 cents; bread, Graham (118), 36, 36 cents; bread, corn (121), 6, 6 cents; rolls (133), 1, 1 cent; scones (142), 3, 3 cents; griddle-cakes (146), 1, 4 cents. Total bread, crackers, etc.	4.7	27.1	867	23.0	789
Cakes (160), 31, 37 cents; cookies (163), 5, 5 cents; pies (174), 2, 8 cents; pudding (177), 4, 16 cents; short-cake (strawberries only) (179), 2, 14 cents; shortcake (crust only) (180), 2, 0[a]; tarts, raspberry (181), 2, 4 cents; ice cream (184), 2, 14 cents; sherbet (188) 1, 6 cents. Total desserts, etc.	5.0	8.2	499	7.0	464
Potatoes, lyonnaise (212), 1, 2 cents	.1	.2	12	.2	11
Bananas (244), 6, 12 cents; strawberries (with cream) (256), 1, 7 cents; preserves, raspberry (257), 1, 4 cents; preserves, strawberry (257), 3, 12 cents. Total fruits	1.7	.4	59	.3	52
Honey (261), 1, 4 cents; sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 100, 0.[a] Total sugars, etc.	.3	....	191	....	187
Cereal coffee (264), 24, 72 cents; cocoa (262), 13, 39 cents; coffee (263), 1, 3 cents; lemonade (267), 2, 4 cents. Total beverages	5.6	1.7	60	1.6	59
Combination breakfasts (270), 6, 60 cents; lunches (273), 15, $1.50; dinners (276), 5, 60 cents. Total combination meals	12.8	24.8	844	22.8	776
Total food	34.1	71.6	2,794	63.8	2,579
Average for three periods	34.3	86.0	3,061	77.2	2,824

[a] See footnote *r* to Table 1

It will be seen that the above dietary provided a simple and tolerably economical ration, with 45 per cent of the total digestible protein and 29 per cent of the available energy furnished by animal foods. Ordinarily in student dietaries studied in the United States, the protein from animal sources, as before stated, has been found to amount to 60 per cent and the energy from the same source to 43 per cent of the total. The most noticeable item of expense was for combination meals, which amounted to nearly 40 per cent of the cost of the day's food, or more than twice the average percentage expenditure for the ten men included in this investigation. Since combination meals were relatively cheap, this was a wise selection. The liberal use of combination meals and the fact that Subject F secured (owing to the almost exclusive use of white and Graham bread), for 1 cent spent on breadstuffs, about 19 per cent more protein and 15 per cent more energy than the average computed for the ten men, are the chief reasons for the economy of the ration. He ate no cereal breakfast foods, and only about 25 per cent as much meat and vegetables as the average. On the other hand, he was fully up to the average on breads, while on desserts he was 25 per cent, and on beverages 200 per cent above the average. The sums expended for the last two articles are the only ones which could not be defended on the ground of economy under the circumstances. It does not necessarily follow that Subject F's ration would have been better adapted to his needs if he had used the money spent on beverages and desserts for the purchase of cheaper foods, because it might well be that such a change would have lessened the very essential element of palatability. It should be borne in mind that all the alterations suggested in favor of greater economy (i. e., increased amounts of nutrients for the same cost) in this case and the others are based on the assumption that within wide limits one food is as acceptable as another to a hungry man, and that the men studied were trying to nourish themselves satisfactorily on a small sum.

As has been noted with a number of the men, Subject F's ration was noticeably lower for period 3 than for the other periods. Thus in periods 1 and 2 the average was 83.9 grams of digestible protein and 2,946 calories of available energy, but in period 3 it was only 63.8 grams and 2,577 calories. This falling off was due chiefly to the decline in the nutritive value of the combination meals (see p. 22) and the increased use of fruits and desserts without a proportionate increase in the total cost of the ration. For the three periods the ration averaged 77.2 grams of digestible protein and 2,824 calories available energy per diem, or 84 and 104 per cent of the amounts called for by the commonly accepted standard for a man of sedentary occupation. We have here another instance of very low protein consumption coupled with a rather plentiful energy supply. So far as we may judge from physical examination and measurements at the end of the test period, Subject F held his own with the demands, both intellectual and physical, of his college life. In fact he showed the slight gain in weight (in this case 1.8 pounds) and in anthropometric measurements that was noticed with the majority of the men, which seems to indicate, at least in the case of a man whose normal body growth was completed, that there was no physical deterioration. His scholarship was very high, if we may judge from the fact that he passed his examinations with the grade of A, the highest mark that is given at Harvard University.

DIETARY STUDY NO. 407.

Subject G was 22 years old, 5 feet 8.5 inches in height, and weighed 143.3 pounds, and, unlike all the subjects before considered, showed a remarkably close approximation to the average for his age both in stature and in physical measurements, being classed as fairly well developed and nourished. He was a senior in the college and carried five courses, none of which was generally considered to be very difficult. Of all the men, his period for sleep was the shortest, being but 6½ to 6¾ hours. He spent 9 to 9¾ hours daily on his college work, but had no outside duties to perform. It was only during period 1 that he took any physical exercise, and then it was limited to walking for 1 to 2 hours or skating for 45 minutes per day on 2 or 3 days.

TABLE 9.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 407.*

SUBJECT G.

[For explanation of numbers in parentheses see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beefsteak (10), 9, 90 cents; beef, rump steak (14), 5, $1; beef, Hamburg steak (13), 1, 10 cents; beef, roast (6), 4, 40 cents; beef, frizzled (with eggs) (23), 1, 10 cents; beef, potpie (25), 1, 10 cents; veal cutlets (27), 1, 15 cents; mutton chops (31) 1, 25 cents; lamb, roast, cold (35), 1, 10 cents; pork, bacon (with eggs) (39), 3, 12 cents; pork cutlets (with fried apples) (43), 2, 30 cents; turkey, roast (with sauce) (54), 1, 15 cents. Total meats, etc	17.5	42.5	597	41.2	519
Chowder (57), 3, 9 cents; soup (59), 6, 18 cents; purée of peas (58), 2, 6 cents. Total soups, etc	1.6	3.1	60	3.0	52
Oysters, raw, ½ dozen (68), 1, 10[a] cents; oyster stew, ordinary (70), 2, 20 cents; oyster stew, special (72), 1, 15 cents; smelts, fried (65), 1, 15[b] cents. Total fish, etc	2.8	3.3	35	3.2	30
Eggs, boiled (77), 2, 16 cents; eggs, fried (78), 7, 56 cents; eggs (with bacon) (78), 3, 24 cents; omelet (81), 1, 10 cents. Total eggs	5.0	8.0	144	7.8	128
Butter (87), 57, 57 cents; milk, glass (95), 10, 20 cents; milk, 4-ounce pitchers (96), 21, 21 cents. Total dairy products	4.7	7.0	355	6.8	330
Oatmeal (103), 21, 84 cents	4.0	7.6	212	6.5	193
Bread, white (113), 16, 16 cents; bread, corn (119) 1, 1 cent; biscuit (125), 4, 4 cents; rolls (131), 67, 67 cents; toast, buttered (135), 8, 24 cents; buckwheat cakes (143), 3, 15 cents; griddlecakes (147), 6, 30 cents; crackers for soup (152), 11, 11 cents. Total bread, crackers, etc	8.0	29.8	1,039	25.3	945
Doughnuts (164), 2, 2 cents; gingerbread (168), 9, 9 cents; cake (158), 2, 5 cents; ice cream (182), 1, 7 cents; pies (172), 11, 55 cents; coffee jelly (185), 9, 36 cents; puddings (175), 9, 45 cents. Total desserts, etc	7.6	10.2	587	8.7	546
Peas (198), 1, 3 cents; potatoes, baked (199), 5, 10 cents; potatoes, fried (207), 2, 4 cents; potatoes, mashed (203), 5, 10 cents; tomatoes, stewed (234), 3, 9 cents. Total vegetables	1.7	2.4	109	2.0	99
Grapes (247), 1, 3 cents; apples, fried (with pork cutlets) (242), 2, 0[c]. Total fruits	.1	....	13	....	11
Sirup (260), 9, 18 cents; sugar, teaspoonfuls (259), 180, 0[c]. Total sugars, etc	.9	....	394	....	386
Cocoa (262), 5, 15 cents; coffee (263), 23, 69 cents; tea (263), 23, 69 cents. Total beverages	7.3	3.7	82	3.6	80
Total food	61.2	117.6	3,627	108.1	3,319
Period 2, 3 weeks, February 14 to March 6.					
Beef, roast (7), 4, 40 cents; beefsteak (11), 1, 10 cents; beef, rump steak (14), 2, 40 cents; beef, tenderloin (15), 1, 50 cents; beef, Hamburg steak (13), 1, 10 cents; beef, corned (3), 2, 16 cents; pork cutlets (43), 1, 15 cents; pork, bacon (with eggs) (40), 3, 12 cents; pork, ham (with eggs) (48), 1, 12 cents; veal, roast (with gravy) (28), 1, 10 cents; gravy (with roast veal) (29), 1, 0;[c] turkey, roast (55), 3, 45 cents; veal cutlets (27), 3, 45 cents; lamb, roast (33), 1, 10 cents. Total meats, etc	15.0	32.6	485	31.6	422
Chowder (57), 3, 9 cents; purée of peas (58), 1, 3 cents; soup (60), 8, 24 cents. Total soups, etc	1.7	2.7	48	2.6	41

[a] Oysters, raw, 15 cents per dozen; 10 cents per half dozen.

[b] Extra charge of 5 cents for Tartare sauce.

[c] See footnote *r* to Table 1.

Table 9.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 407*—Continued.

SUBJECT G—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 2, 3 weeks, February 14 to March 6—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Cod, fried (62), 2, 22 cents; halibut, fried (63), 2,[a] 25 cents; oyster stew (71), 1, 10 cents; oyster stew, extra (72), 2, 30 cents. Total fish, etc	4.1	9.9	109	9.6	93
Eggs, fried (79), 8, 64 cents; eggs, scrambled (85), 2, 20 cents; eggs, fried (with bacon) (79), 3, 24 cents; eggs, fried, (with ham), (79), 1, 8 cents. Total eggs, etc	5.5	9.9	195	9.6	174
Butter (88), 56, 56 cents; milk, glass (95) 24, 48 cents; milk, 4-ounce, pitchers (96), 25, 25 cents. Total dairy products	6.1	12.0	508	11.6	472
Oatmeal (104), 21, 63 cents; rice (107) 4, 12 cents. Total breakfast cereals, etc	3.6	5.7	172	4.8	157
Bread, white (114), 14, 14 cents; bread, corn (120), 21, 21 cents; biscuit (126), 1, 1 cent; rolls (132), 52, 52 cents; toast, buttered (135), 14, 42 cents; crackers (153), 11, 11 cents; buckwheat cakes (144), 2, 10 cents; griddlecakes (145), 7, 35 cents. Total breads, crackers, etc	8.9	30.7	1,092	26.1	994
Cake (159), 3, 6 cents; gingerbread (169), 2, 2 cents; pie (173), 7, 35 cents; pudding (176), 2, 8 cents; coffee jelly (186), 14, 56 cents; ice cream (183), 1, 7 cents. Total desserts, etc	5.4	5.8	315	4.9	293
Peas (196), 5, 15 cents; potatoes, baked (200), 4, 8 cents; potatoes, mashed (204), 8, 16 cents; sweet potatoes (217), 1, 2 cents; beets, pickled (219), 1, 3 cents; tomatoes, stewed (232), 2,[a] 8 cents. Total vegetables, etc	2.4	3.3	127	2.7	116
Bananas (243), 37, 74 cents; fried apples (with pork cutlets) (242), 1, 0;[b] oranges (250), 21, 63 cents. Total fruits, etc	6.5	3.6	269	3.1	237
Sirup (260), 9, 18 cents; sugar (259), 177, 0.[b] Total sugars, etc	.9	....	388	....	380
Cocoa (262), 2, 6 cents; coffee (263), 27, 81 cents; ginger ale (266), 1, 5 cents; tea (263), 17, 51 cents. Total beverages, etc	6.8	3.3	76	3.2	75
Combination lunch (272), 1, 10 cents	.5	1.5	47	1.4	43
Total food	67.4	121.0	3,831	111.2	3,497
Period 3, 3 weeks, May 8 to May 28.					
Beef, braised (2), 1, 10 cents; beef, corned (4), 2, 16 cents; beef, roast (8), 5, 50 cents; beefsteak (12), 4, 40 cents; beef, rump steak (14), 3, 60 cents; pork, bacon (with eggs) (41), 1, 4 cents; pork cutlets (43), 2, 30 cents; pork, ham (with eggs) (48), 2, 24 cents; turkey, roast and dressing (56), 1, 15 cents. Total meats, etc	11.9	33.1	474	32.1	412
Chowder (57), 3, 9 cents; soup (61), 6, 18 cents. Total soups, etc	1.3	2.5	45	2.4	39
Mackerel, broiled (64), 2, 20 cents	1.0	3.0	25	2.9	21
Eggs, fried (80), 18,[c] 54 cents; eggs, scrambled (86), 7, 56 cents; eggs (with bacon) (80), 1, 6 cents; eggs (with ham) (80), 2, 12 cents. Total eggs, etc	6.1	20.4	423	19.8	376
Butter (89), 52, 52 cents; cream (92), 2, 4 cents; cream (with strawberries) (93), 16, 0;[b] milk, bowl (94), 2, 8 cents; milk, glass (95), 49, 98 cents; milk, 4-ounce pitchers (96), 6, 6 cents. Total dairy products	8.1	18.8	717	18.2	667
Oatmeal (105), 2, 6 cents; rice (108), 1, 3 cents; shredded wheat (109), 6,[c] 12 cents. Total breakfast cereals, etc	1.0	1.7	58	1.5	53
Bread, white (115), 18, 18 cents; bread, corn (121), 40, 40 cents; rolls (133), 30, 30 cents; toast, buttered (136), 15, 45 cents; griddlecakes (146), 10, 40 cents; crackers (154), 2, 2 cents. Total bread, crackers, etc	8.3	30.3	1,052	25.8	957
Cake (160), 6, 9 cents; cookies (163), 2, 2 cents; ice cream (184), 8, 64[d] cents; coffee jelly (187), 8, 32 cents; sherbet (188), 1, 6 cents. Total desserts	5.4	3.6	213	3.1	198

[a] Includes one special order, with extra charge.
[b] See footnote r to Table 1.
[c] Orders for one-half the usual amount.
[d] Includes some kinds of ice cream the price of which was higher than that in Table 1.

TABLE 9.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 407*—Continued.

SUBJECT G—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Peas (197), 5, 10 cents; potatoes, baked (201), 3, 6 cents; potatoes, mashed (205), 6, 12 cents; potatoes, fried (208), 1, 2 cents; potatoes, lyonnaise (212), 3, 6 cents; beets, pickled (219), 1, 8 cents; onions, raw (226), 2, 6 cents; pickles (239), 3, 3 cents; tomatoes (233), 1, 2 cents. Total vegetables	2.4	3.3	138	2.7	126
Apples, fried (with pork cutlets) (242), 2, 0;[a] bananas (244), 13, 26 cents; oranges (251), 8, 24 cents; strawberries (256), 16, $1.36. Total fruits, etc	8.9	2.3	141	2.0	124
Sirup (260), 10, 20 cents; sugar (259), 55, 0.[a] Total sugars, etc	1.0	....	192	....	188
Coffee (263), 5, 15 cents; tea (263), 16, 48 cents. Total beverages	3.0	1.5	31	1.5	30
Total food	58.4	120.5	3,509	112.0	3,191
Average of the three periods	62.3	119.7	3,656	110.4	3,336

[a] See footnote *r* to Table 1.

The diet of Subject G is especially interesting, as this is the only instance among the ten men studied in which the cost of board was apparently of little moment. An increased variety and quantity of food are noticeable. Thus, for the three periods the daily ration cost on an average 62.3 cents and contained 110.4 grams of digestible protein and 3,336 calories of available energy, quantities which approach closely to the standard for men with moderately active muscular work, i. e., 115 grams of digestible protein and 3,400 calories of available energy (see Table 14, p. 54). The quantity of protein furnished by animal foods (62.5 per cent of the total amount mentioned above) was higher than the average for the ten men studied. The fact that no combination meals were used is noticeable, and explains the liberal use of many of the other food articles, such as meats, eggs, soups, and desserts. The nutrients in the ration might have been increased without altering the cost by spending less on desserts, beverages, and fruits, of which about 25 per cent more than the average were consumed, and purchasing proportionately more of the cheaper foods, but as economy seems to have been no object there is really little reason to suggest possible changes. The effect of the selection of a variety of dishes within any given food class in lowering the economy of that class is well illustrated in this dietary.

For example, every cent's worth of meats, fish, and eggs procured supplied only about 80 per cent of the protein and 85 per cent of the energy obtained on an average with less variety by the ten men studied. For breads the figures are 75 and 80 per cent, respectively, and for vegetables 63 and 60 per cent, respectively. A glance at the table shows the relatively great variety in the above classes of food.

At the end of the investigation the subject had gained 6.2 pounds in weight and showed a corresponding slight increase in anthropometric measurements. No change in his general physical condition could be noted. He passed his examinations creditably with a grade between B and C.

In this case there can be little doubt that the supply of nutrients was actually sufficient to meet the subject's demands, inasmuch as he gained in weight and showed no sign of physical deterioration. The ration eaten by Subject G, although very liberal in comparison with that of the other men included in this investigation, should not be regarded as excessively large, and the average student who boarded at Randall Hall and was not forced to economize would probably spend fully as much on his food and secure as much protein and energy as did this subject.

DIETARY STUDY NO. 408.

Subject H was 27 years old, 5 feet 10.5 inches in height, and weighed 128.3 pounds. For one of his height he was very slight, but examination showed that he was in fair physical condition and fairly well nourished.

He was a senior in the college and carried five courses, none of which was commonly regarded as especially difficult. He slept about 8 hours and devoted 7 to 8¼ hours daily to his studies. For exercise he walked or rode a bicycle 30 minutes to 1 hour per day for seven days during period 1. In the winter period (period 2) he walked or exercised in the gymnasium 1 hour daily for 10 days, and in period 3 he rode a bicycle 30 minutes to 2 hours daily on 6 days. In addition to college work he served as a waiter at Randall Hall for ¾ to 1½ hours daily for 10 to 13 days during each period. His time was quite fully occupied, but his physical work was not of a very arduous nature.

TABLE 10.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 408.*

SUBJECT H.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.					
Beefsteak (10), 3, 30 cents; beef, roast (6), 3, 30 cents; beef croquettes (18), 1, 10 cents; lamb, roast, with sauce (32), 1, 10 cents; pork, sausage (50), 1, 8 cents; turkey, roast (with dressing) (51), 1, 15 cents.	*Cents.*	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Total meats, etc	4.9	15.0	178	14.6	155
Soup (59), 15, 45 cents	2.1	3.9	61	3.8	52
Whitefish, baked (66), 1, 10 cents	.5	1.5	11	1.5	9
Egg omelet (81), 2, 20 cents	.9	1.9	36	1.8	32

TABLE 10.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 408*—Continued.

SUBJECT H—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20—Cont'd.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Butter (87), 28, 28 cents; milk, bowl (hot), (94), 3, 15 cents; milk, glass (95), 3, 6 cents; milk, 4-ounce pitchers (96), 38, 38 cents. Total dairy products	4.1	9.2	324	8.9	301
Prepared cereal (97), 8, 32 cents; oatmeal (103) 17, 68 cents; rice (106), 2, 8 cents; shredded wheat (109), 8, 32 cents; wheat (112), 3, 12 cents. Total breakfast cereals	7.2	12.5	405	10.6	369
Bread, white (113), 44, 44 cents; bread, corn (119), 48, 48 cents; rolls (131), 23, 23 cents; toast, buttered (135), 8, 24 cents; griddlecakes (147), 1, 5 cents. Total bread, crackers, etc	6.9	27.9	958	23.7	872
Cake (158), 18, 24 cents; cookies (161), 17, 17 cents; gingerbread, (168), 1, 1 cent; pies (172), 4, 20 cents; puddings (175), 6,[a] 28 cents; coffee jelly (185), 4, 16 cents. Total desserts, etc	5.0	8.6	496	7.3	461
Beans, baked (189), 7, 28 cents; potatoes, baked (199), 12, 24 cents; potatoes, fried (207), 2, 4 cents; potatoes, mashed (203), 11, 22 cents; sweet potatoes (216), 5, 10 cents; tomatoes, stewed (234), 3, 9 cents. Total vegetables	4.6	11.6	401	9.6	365
Bananas (245), 1, 2 cents; grapes (247), 2, 6 cents; preserves (257), 6, 24 cents. Total fruits	1.5	.2	58	.2	51
Sirup (260), 1, 2 cents; sugar, teaspoonfuls (259), 118, 0.[b] Total sugars, etc	.1	....	210	....	206
Coffee (263), 4, 12 cents	.6	.3	6	.3	6
Total food	38.4	92.6	3,144	82.3	2,879
Period 2, 3 weeks, February 14 to March 6.					
Beef, roast (7), 1, 10 cents; beef, corned (3), 2, 16 cents; beefsteak (11), 1, 10 cents; beef croquettes (19), 1, 10 cents; beef hash (21), 1, 7 cents; lamb, roast (33), 4, 40 cents; chicken wings (with toast), (52), 1, 10 cents. Total meats, etc	4.9	15.0	171	14.5	149
Soup (60), 7, 21 cents	1.0	1.3	18	1.3	16
Butter (88), 47, 47 cents; milk, glass (95), 2, 4 cents; milk, bowl (hot), (94), 1, 5 cents; milk, 4-ounce pitchers (96), 31, 31 cents. Total dairy products	4.1	6.7	352	6.5	327
Oatmeal (104), 20, 60 cents; rice (107), 1, 3 cents; shredded wheat (109), 3, 12 cents; wheat (110), 6, 18 cents. Total breakfast cereals, etc	4.4	7.1	223	6.0	203
Bread, white (114), 16, 16 cents; bread, corn (120), 50, 50 cents; biscuit (126), 1, 1 cent; rolls (132), 53, 53 cents; toast (with chicken wings) (139), 1, 0;[b] toast, buttered (135), 8, 24 cents; toast, creamed (138), 1, 7 cents; griddlecakes (145), 2, 10 cents; crackers (153), 4, 4 cents. Total bread, crackers, etc	7.9	30.1	1,065	25.6	969
Cookies (162), 11, 11 cents; gingerbread (169), 7, 7 cents; coffee jelly (186), 13, 52 cents; cake (159), 25, 30 cents; pie (173), 4, 20 cents; pudding (176), 5, 20 cents; tarts (181), 1, 2 cents; fritters, apple (171), 1, 7 cents. Total desserts	7.1	10.8	601	9.2	559
Beans, baked (190), 1, 4 cents; peas (196), 1, 3 cents; potatoes, baked (200), 6, 12 cents; potatoes, mashed (204), 10, 20 cents; sweet potatoes (217), 2, 4 cents; tomatoes, stewed (232), 4, 12 cents; turnips, mashed (235), 1, 3 cents; pickles, sweet (237), 2, 10 cents. Total vegetables	3.2	4.8	190	4.0	173
Apples, baked (241), 1, 4 cents; bananas (243), 6, 12 cents; figs, dried (249), 4, 16 cents; oranges (250), 9, 27 cents; preserves, damson (257), 5, 20 cents. Total fruits	3.8	1.8	164	1.5	144
Sugar (259), 95, 0;[b] sirup (260), 2, 4 cents. Total sugars, etc	.2	....	180	....	176
Cocoa (262), 1, 3 cents	.1	.1	3	.1	3
Combination lunch (272), 1, 10 cents	.5	1.5	47	1.4	43
Total food	37.2	79.2	3,014	70.1	2,762

[a] Includes one order at 3 cents.

[b] See footnote *r* to Table 1.

TABLE 10.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 408*—Continued.

SUBJECT H—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beef, roast (8), 2, 20 cents; beef, corned (4), 2, 16 cents; beefsteak (12), 3, 30 cents; beef, frizzled with eggs (24), 1, 9 cents; lamb, roast (34), 2, 20 cents; chicken wings (with toast) (53), 1, 10 cents. Total meats, etc	5.0	13.0	149	12.6	130
Soups (61), 4, 12 cents	.6	1.2	17	1.2	15
Eggs, dropped (77), 6,[a] 18 cents	.8	1.9	24	1.8	21
Butter (89), 43, 43 cents; cream (with strawberries) (93), 1, 0;[b] milk, glass (95), 5, 10 cents; milk, 4-ounce pitchers (96), 20, 20 cents. Total dairy products	3.5	5.3	322	5.1	299
Oatmeal (105), 16, 48 cents; shredded wheat (109), 11,[a] 22 cents; wheat (111), 3, 9 cents. Total breakfast cereals	3.8	7.3	228	6.2	207
Bread, white (115), 22, 22 cents; bread, corn (121), 49, 49 cents; biscuit (127), 1, 1 cent; rolls (133), 45, 45 cents; toast, buttered (136), 2, 6 cents; toast (with chicken wings) (139), 1, 0.[b] Total bread, crackers, etc	5.9	26.3	903	22.4	822
Cake (160), 16, 16 cents; cookies (163), 9, 9 cents; doughnuts (166), 1, 1 cent; gingerbread (170), 3, 3 cents; pie (174), 14,[c] 57 cents; puddings (177), 4, 16 cents; coffee jelly (187), 7, 28 cents; ice cream (184), 2, 14 cents; sherbet (188), 1, 6 cents. Total desserts, etc	7.1	10.9	674	9.3	627
Beans, baked (191), 1, 4 cents; beans, Lima (194), 2, 4 cents; peas (197), 2, 4 cents; potatoes, baked (201), 8, 16 cents; potatoes, mashed (205), 9, 18 cents; potatoes, stewed (206), 1, 2 cents; succotash (231), 4, 8 cents; tomatoes, stewed (233), 5, 10 cents; turnips (235), 1, 2 cents; potato salad (215), 1, 5 cents; corn (225), 1, 2 cents. Total vegetables	3.6	5.9	197	4.9	179
Bananas (244), 3, 6 cents; oranges (251), 2, 6 cents; strawberries (with cream) (256), 1, 7 cents; preserves (257), 8, 32 cents; sauces (258), 3, 12 cents. Total fruits	3.0	.6	97	.5	85
Sugar (259), 130, 0[b]	....	....	220	....	216
Coffee (263), 3, 9 cents; lemonade (267), 21, 42 cents; tea (263), 3, 9 cents. Total beverages	2.8	.4	99	.4	97
Combination lunches (273), 3, 30 cents	1.4	2.4	97	2.2	89
Total food	37.5	75.2	3,027	66.6	2,787
Average of the three periods	37.7	82.3	3,062	73.0	2,809

[a] Orders for one-half the usual amount.
[b] See footnote *r* to Table 1.
[c] Includes one order at 5 cents.

The results of the dietary study show that the food contained on an average for the three periods 73 grams of digestible protein and 2,809 calories of available energy, and cost about 37.7 cents per day. Although the cost remained fairly constant, the value of the day's ration fell off uniformly toward a minimum in period 3. The diet was quite largely vegetarian in character, animal foods furnishing only 34.5 per cent of the total protein and 18.5 per cent of the total energy noted above. Only about 10 per cent of the average number of combination meals was eaten. Meats furnished about the usual proportion of total nutrients, but dairy products furnished only about 80 per cent of their usual proportion.

On the other hand, the vegetable foods, as might be inferred, were consumed in greater quantities than usual. Thus the expenditure for breads was about 25 per cent, for cereals about 65 per cent, for desserts about 150 per cent, and for vegetables about 40 per cent above the average. There was a noticeable decline in the amount of protein in the diet during the second and third periods, while the price of the diet per day remained nearly the same; thus in the three periods, the ratio of digestible protein to available energy was 1 gram to 35 calories, 1 gram to 40 calories, and 1 gram to 42 calories, respectively. Perhaps the chief reasons for this were decrease in the amount of protein obtained per money unit expended for meats in period 3, the use of more butter and cream and less milk in both periods 2 and 3, and a general tendency toward a more liberal purchase of the less economical foods.

At the end of the investigation Subject H had gained 4.8 pounds and showed the usual slight increase in anthropometric measurements and in strength-test figures. Medical examination showed no change in his general physical condition. In the examinations at the end of the college year he attained an average grade of about B.

We have, then, in the case of Subject H a student rather older than the average of those studied, who performed a creditable year's work at college on a diet somewhat vegetarian in nature, which averaged for the three test periods 73 grams of digestible protein and 2,809 calories of available energy, amounts which are respectively 79.5 and 104 per cent of those called for by the commonly accepted standard for a man of sedentary habits, without showing any evidence of physical deterioration. In fact, in this instance the gain of nearly 5 pounds is ground for believing that he was certainly in equilibrium with his environment, especially since he had passed the age of greatest bodily development.

DIETARY STUDY NO. 409.

Subject I was 16 years old, 5 feet 4.2 inches in height, and weighed 110¼ pounds. He was classed as well developed and well nourished, though compared with the average college student of the same age his measurements were a little below the normal. He was a freshman in the college and took the usual broad foundation studies, carrying, however, six instead of the customary five courses, which gave him a rather full year's work. He slept from 8¼ to 8½ hours and spent from 7½ to 8¾ hours daily in college work. In addition to this he did clerical work amounting to a total of 36 to 45 hours in the first, 9 to 24 hours in the second, and 4 to 10 hours in the third period. He took very little exercise. Thus, during the three weeks of period 1 he walked 4 hours, during period 2 he walked 1 to 2 hours, and during period 3 he took an hour's walk on one occasion and on another he rode a bicycle for 5 hours.

TABLE 11.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 409.*

SUBJECT I.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.	*Cents.*	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Soup (59), 5, 15 cents	0.7	1.0	16	1.0	14
Butter (87), 12, 12 cents; milk, bowl (94), 14, 56 cents; milk, 4-ounce pitchers (96), 42, 42 cents. Total dairy products	5.2	10.0	272	9.7	253
Hominy (100), 9, 36 cents; oatmeal (103), 11, 44 cents; rice (106), 2, 8 cents; wheat (112), 20, 80 cents. Total breakfast cereals, etc	8.0	10.3	362	8.8	329
Bread, white (113), 8, 8 cents; bread, Graham (116) 9, 9 cents; bread, corn (119), 16, 16 cents; biscuit (125), 5, 5, cents; rolls (131), 44, 44 cents; crackers for soup (152), 5, 5 cents. Total bread, crackers, etc	4.1	19.2	669	16.3	609
Cake (158), 2, 2 cents; cookies (161), 3, 3 cents; doughnuts (164), 3, 3 cents; gingerbread (168), 6, 6 cents. Total desserts, etc	.7	1.7	116	1.4	108
Potatoes, mashed (203), 5, 10 cents	.5	.9	38	.7	35
Sugar, teaspoonfuls (259), 203, 0[a]	....	....	343	....	336
Cocoa (262), 7, 21 cents	1.0	.7	19	.7	19
Combination dinners (274), 3, 36 cents	1.7	4.6	110	4.2	101
Total food	21.9	48.4	1,945	42.8	1,804
Period 2, 3 weeks, February 14 to March 6.					
Beefsteak (11), 1, 10 cents	.5	1.7	16	1.7	14
Chowder (57), 1, 3 cents; soup (60), 2, 6 cents. Total soups, etc	.4	.7	12	.7	10
Butter (88), 17, 17 cents; milk, bowl (94), 18, 72 cents; milk, 4-ounce pitchers (96), 22, 22 cents. Total dairy products	5.3	14.2	383	13.8	263
Prepared cereal (98), 1, 4 cents; oatmeal (104), 19, 57 cents; rice (107), 1, 3 cents; wheat (110), 1, 3 cents. Total breakfast cereals	3.2	5.3	156	4.5	142
Bread, white (114), 15, 15 cents; bread, corn (120), 9, 9 cents; biscuit (126), 2, 2 cents; rolls (132), 89, 89 cents; gems, Graham (128), 2, 2 cents; crackers (153), 3, 3 cents. Total bread, crackers, etc	5.7	25.7	877	21.8	798
Cake (159), 7, 15 cents; doughnuts (165), 3, 3 cents; éclair (167), 2, 8 cents; pie (173), 8, 40 cents. Total desserts, etc	3.1	4.3	285	3.7	265
Beans, baked (190), 1, 4 cents; potatoes, baked (200), 1, 2 cents; potatoes, mashed (204), 1, 2 cents. Total vegetables	.4	1.3	32	1.1	29
Apples (240), 1, 2 cents; bananas (243), 4, 8 cents. Total fruits	.5	.2	22	.2	19
Sugar, teaspoonfuls (259), 204, 0[a]	....	....	345	....	338
Cocoa (262), 21, 63 cents	3.0	2.0	57	1.9	56
Combination breakfast (269), 1, 10 cents; lunches (272), 18, $1.80; dinners (275), 2, 24 cents. Total combination meals	10.2	31.5	956	29.0	879
Total food	32.3	86.9	3,141	78.4	2,813
Period 3, 3 weeks, May 8 to May 28.					
Beef hash (22), 1, 6 cents	.5	1.5	22	1.5	19
Butter (89), 23, 23 cents; milk, bowl (94), 19, 76 cents; milk, 4-ounce pitchers (96), 21, 21 cents. Total dairy products	5.7	14.6	427	14.2	397
Oatmeal (105), 20, 60 cents; rice (108), 1, 3 cents. Total breakfast cereals	3.0	6.7	189	5.7	172
Bread, white (115), 17, 17 cents; bread, corn (121), 1, 1 cent; biscuit (127), 8, 8 cents; rolls (133), 100, $1; macaroni (156), 2, 12 cents. Total bread, crackers, etc	6.6	31.4	1,074	26.7	977
Cake (160), 11, 14 cents; pie (174), 10,[b] 42 cents; shortcake, strawberries only (179), 1, 7 cents; shortcake, crust only (180), 1, 0;[a] sherbet (188), 2, 12 cents. Total desserts, etc	3.5	5.1	346	4.3	322
Beans, baked (191), 1, 4 cents; potatoes, hashed (214), 1, 2 cents; potatoes, fried (208), 1, 2 cents. Total vegetables	.4	1.2	48	1.0	41
Sugar, teaspoonfuls (259), 217, 0[a]	....	....	367	....	360

[a] See footnote *r* to Table 1.

[b] Includes two orders of pie at 5 cents each.

TABLE 11.—*Kinds of food, number of orders, and cost of each kind, and average cost and amounts of protein and energy of dietary study No. 409*—Continued.

SUBJECT I—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 3, 3 weeks, May 8 to May 28—Continued.					
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Cocoa (262) 16, 48 cents; lemonade (267), 9, 18 cents; tea (263), 1, 3 cents. Total beverages	3.3	1.6	84	1.6	82
Combination lunches (273), 15, $1.50; dinners (276), 3, 36 cents. Total combination meals	8.9	15.7	574	14.4	528
Total food	31.9	77.8	3,131	69.4	2,901
Average of the three periods	28.7	71.0	2,739	63.5	2,506

The diet of this subject is noteworthy in several respects. During the three weeks of period 1 he lived on a ration which cost about 22 cents per day and supplied the remarkably small total of 42.8 grams of digestible protein and 1,804 calories of available energy. He ate no meat except that which was served with the combination meals, of which there were only three during the entire period. Except for butter and milk, which supplied about 25 per cent of the total protein and 14 per cent of the total energy, he was practically a vegetarian, depending on breads and cereals for about 59 per cent of the total protein and on bread, cereals, and sugar for 70.5 per cent of the total energy obtained. Two pages from his book will give an idea of the character of the diet which he selected, though, as will be observed from the table above, the total number of combination meals was very small.

Sample menus, Subject I.

DECEMBER 2.

	Cost, cents.
Breakfast:	
Cracked wheat and milk (with 3 to 4 teaspoonfuls sugar)	5
One hot biscuit (about 57 grams)	1
Total	6
Lunch:	
Boiled rice and milk (with 3 to 4 teaspoonfuls sugar)	5
Corn bread (about 43 grams)	1
Total	6
Dinner:	
Combination dinner, which consisted of a plate of soup, roast turkey and dressing, a small saucer of mashed tomatoes, a saucer of stewed corn (about two teaspoonfuls), a roll, a small pat of butter (11 grams), a cup of cocoa, and a dish of pudding (150 grams)	16
Total cost for the day	28

DECEMBER 17.

	Cost, cents.
Breakfast:	
Cracked wheat and milk (with 3 to 4 teaspoonfuls sugar)	5
Two biscuits	2
Pat of butter	1
Total	8
Dinner:	
Boiled hominy and milk (with 3 to 4 teaspoonfuls sugar)	5
Four slices bread	2
Pat of butter	1
Total	8
Supper:	
Bowl of milk (about 12 fluid ounces)	4
Two rolls (48 grams each)	2
Total	6
Total cost for the day	22

Subject I apparently found that he did not get enough to eat in this manner for 22 cents a day, and accordingly we find him spending more at the time covered by the second and third periods. On an average his daily ration then cost about 32 cents and furnished 73.9 grams of digestible protein and 2,857 calories of available energy. During these periods animal foods furnished 43.5 per cent of the total protein and 26 per cent of the total energy noted, a ratio which was not materially different from that shown in the dietaries of several of the other subjects. The diet, as in many other cases, could have been improved as regards economy by spending less on desserts and beverages and more on some other foods. As the tables stand, the ration for periods 2 and 3 furnishes more than the average amounts of nutrients for 1 cent, as compared with the other studies, and this is due largely to the fact that the ration was simple as regards the classes of foods selected. It is further true that Subject I chose to eat only a few simple foods of each class rather than a considerable variety, and this explains the fact that in every important food class he obtained for 1 cent amounts of nutrients never below and often a little above the corresponding average amounts for the ten men.

At the end of the investigation he weighed 127 pounds, having made the surprising gain of 16.8 pounds during the experimental period, and his anthropometric measurements, as might be expected, also show a marked increase. No change, except an increase in adipose tissue, etc., was found in his physical condition and general health, but it seems certain that there was no deterioration. He passed the final examinations in all his studies with an average grade of B. When we remember that he carried six courses and did outside clerical work in addition to his college work, this is a very creditable showing.

It appears, then, that this subject, 16 years old at the beginning of the investigation, performed his college work with credit and gained steadily in bodily weight throughout the year without the slightest sign of deterioration in his general physical condition on a diet which furnished on an average 63.5 grams of digestible protein and 2,506 calories of available energy per diem.

DIETARY STUDY NO. 410.

Subject K was 22 years old, 5 feet 6.8 inches in height, and weighed 151 pounds. He alone of all the men studied seemed thoroughly strong and robust physically, and such a man as one would consider fit to take an active part in college athletics. His anthropometric measurements showed him to be generally above the normal for men of his age and he was classed on examination as well developed and well nourished.

He was a senior in the college and devoted himself to the study of Greek and classical philology, carrying four and one-half advanced courses. On an average he spent daily 10 to 11¼ hours on college work, including lectures, reading, etc., and slept 6¾ to 7 hours. His only physical exercise for the entire three periods was a walk of an hour, but during the first period he served as a waiter at Randall Hall 1½ to 3 hours daily for 16 days, during the second period 1 to 4 hours daily for 17 days, and during the third period 2¼ to 4½ hours daily for the entire three weeks. From this it appears that his working day covered 12 to 14 hours.

TABLE 12.—*Kinds of food, number of orders, cost of each kind, and average cost and amounts of protein and energy of dietary study 410.*

SUBJECT K.

[For explanation of numbers in parentheses, see p. 11.]

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20.	*Cents.*	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Beefsteak (10), 1, 10 cents	0.5	1.4	14	1.4	12
Chowder (57), 2, 6 cents; purée of peas (58), 1, 3 cents; soup (59), 2, 6 cents. Total soups, etc	.7	1.5	29	1.5	25
Milk, bowl (94), 3, 12 cents; milk, glass (95), 1, 2 cents; milk, 4-ounce pitchers (96), 2, 2 cents. Total dairy products	.7	2.4	52	2.3	48
Prepared cereal (97), 1, 4 cents; hominy (100), 8, 32 cents; oatmeal (103), 2, 8 cents; wheat (112), 1, 4 cents. Total breakfast cereals, etc.	2.3	2.7	107	2.3	100
Bread, white (113), 13, 13 cents; bread, Graham (116), 41, 41 cents; bread, corn (119), 4, 4 cents; rolls (131), 1, 1 cent; crackers (152), 2, 2 cents. Total breads, crackers, etc	2.9	16.8	546	14.3	497

TABLE 12.—*Kinds of food, number of orders, cost of each kind, and average cost and amounts of protein and energy of dietary study 410*—Continued.

SUBJECT K—Continued.

Kinds of food, number of orders, and cost of each kind.	Cost, protein, and energy of daily food.				
	Total.			Digestible protein.	Available energy.
	Cost.	Protein.	Energy.		
Period 1, 3 weeks, November 30 to December 20—Cont'd.					
Doughnuts (164), 1, 1 cent; gingerbread (168), 1, 1 cent; pie (172), 1, 5 cents; ice cream (182), 1, 7 cents. Total desserts, etc	*Cents.* 0.7	*Grams.* 0.7	*Calories.* 50	*Grams.* 0.6	*Calories.* 47
Beans, baked (189), 2, 8 cents; potatoes, baked (199), 26, 52 cents; sweet potatoes (216), 31, 62 cents. Total vegetables	5.8	14.3	790	11.9	719
Sugar, teaspoonfuls (259), 19, 0[a]	....	....	32	....	31
Combination dinner (274), 1, 12 cents	.6	1.5	37	1.4	34
Total food	14.2	41.3	1,657	35.7	1,513
Period 2, 3 weeks, February 14 to March 6.					
Beefsteak (11), 11, $1.10	5.2	18.6	179	18.0	156
Purée of peas (58), 3, 9 cents; soup (60), 1, 3 cents. Total soups, etc	.6	1.3	28	1.3	24
Eggs, boiled (77), 7,[b] 28 cents; eggs, fried (79), 4, 32 cents. Total eggs	2.9	4.3	68	4.2	61
Butter (88), 7, 7 cents; milk, glass (95), 10, 20 cents; milk, bowl (91), 1, 4 cents. Total dairy products	1.5	3.8	112	3.7	104
Prepared cereals (98), 2, 8 cents; hominy (101), 6, 18 cents; oatmeal (104), 9, 27 cents; rice (107), 3, 9 cents; wheat (110), 9, 27 cents. Total breakfast cereals, etc	4.2	6.3	225	5.4	205
Bread, white (114), 13, 13 cents; bread, Graham (117), 71, 71 cents; bread, corn (120), 36, 36 cents. Total bread, crackers, etc	5.7	31.5	1,037	26.8	944
Cake, fruit (159), 28, 28 cents; cookies (162), 2, 2 cents; gingerbread (169), 3, 3 cents. Total desserts, etc	1.6	4.3	267	3.7	248
Beans, baked (190), 1, 4 cents; potatoes, baked (200), 24, 48 cents; sweet potatoes (217), 13, 26 cents. Total vegetables	3.7	8.7	434	7.2	395
Bananas (243), 3, 6 cents	.3	.2	14	.2	12
Sugar, teaspoonfuls (259), 61, 0[a]	....	....	103	....	101
Coffee (263), 1, 3 cents	.1	.1	2	.1	2
Total food	25.8	79.1	2,469	70.6	2,252
Period 3, 3 weeks, May 8 to May 28.					
Beefsteak (12), 3, 30 cents	1.4	4.8	46	4.7	40
Soups (61), 2, 6 cents	.3	.6	9	.6	8
Eggs, fried (80), 5, 30 cents	1.4	2.6	50	2.5	45
Butter (89), 20, 20 cents; milk, bowl (94), 1, 4 cents. Total dairy products	1.2	.7	111	.7	103
Prepared cereal (99), 7, 28 cents; hominy (102), 7, 21 cents; oatmeal (105), 10, 30 cents, wheat (111), 6, 18 cents. Total breakfast cereals	4.6	8.4	287	7.1	261
Bread, white (115), 18, 18 cents; bread, Graham (118), 73, 73 cents. Total bread	4.3	25.8	826	21.9	752
Cake (160), 2, 2 cents; cookies (163), 1, 1 cent; pie (174), 8, 32 cents. Total desserts, etc	1.7	2.7	194	2.3	180
Potatoes, baked (201), 28, 56 cents; potatoes, boiled (202), 13, 26 cents. Total vegetables	3.9	6.7	270	5.6	246
Bananas (244), 16, 32 cents	1.5	.9	69	.8	61
Sugar, teaspoonfuls (259), 49, 0[a]	....	....	83	....	81
Total food	20.3	53.2	1,945	46.2	1,777
Average for the three periods	20.3	57.9	2,024	50.8	1,847

[a] See footnote *r* to Table 1.

[b] Orders for half the usual amount.

The above dietary is especially noteworthy because of the unusually small amount of nutrients and energy eaten daily, and also because of the low cost. On an average for the three periods the ration cost but 20.1 cents per day, and furnished 50.8 grams of digestible protein and 1,847 calories of available energy, only 55 and 68.5 per cent, respectively, of the amounts called for by the commonly accepted standard for men of sedentary occupation.

Animal foods furnished about 24 per cent of the total protein and 11 per cent of the total energy, the lowest ratio of animal to vegetable nutrients noted in the entire investigation. Practically no combination meals were used; meats furnished only about 75 per cent, and dairy products only about 33 per cent, of the quantity of protein and energy derived from foods of this kind in the average for all ten subjects. From this it is evident that the consumption of the common animal foods was very small. On the other hand, the vegetable and cereal foods were very liberally used; for example, vegetables furnished 16 per cent of the total protein and 25 per cent of the total energy, or about three and one-half times the average percentage for all the subjects; breads nearly 50 per cent, and cereals 80 per cent more than the average percentage amount noted in these studies. From the point of view of economy of purchase no criticism need be made of this dietary, as the choice of dishes was such that little more could have been bought for the same money. However, from a consideration of the records in the subject's daybook, selected at random, the diet would appear to be far from what is ordinarily considered normal, palatable, or satisfactory.

Sample menus, Subject K.

DECEMBER 15.

	Cost, cents.
Breakfast:	
Baked beans	4
Graham crusts (about equal to 2 slices of bread)	1
Baked potatoes	2
Total	7
Lunch:	
Cracked wheat and small pitcher of milk (4 ounces)	5
Supper:	
Two Graham crusts (about equal to 4 slices of bread)	2
Cup of hot water	0
Total	7
Total cost for the day	14

FEBRUARY 14.

Breakfast:	
Steak	10
Graham bread (2 slices)	2
Oatmeal (with sugar, but no milk)	3
Hot water	0
Total	15

	Cost, cents.
Lunch:	
Cracked wheat (with sugar, but no milk)	3
Baked potatoes (2 potatoes)	2
Graham crusts (see above)	1
Total	6
Supper:	
Two Graham crusts (see above)	2
Pat of butter (about 12 grams)	1
Fruit cake (1 small square)	1
Cup of hot water	0
Total	4
Total cost for the day	25

MAY 24.

Breakfast:	
Oatmeal (sugar, but no milk)	3
Baked potatoes (2 potatoes)	2
Graham crusts	1
Cup of hot water	0
Total	6
Lunch:	
Boiled hominy (sugar, but no milk)	3
Two Graham crusts	2
Baked potatoes (same as above)	2
Cup of hot water	0
Total	7
Supper:	
Boiled potatoes (2 potatoes)	2
Bread (4 slices of white bread)	2
Saucer of prepared cereal	3
Cup of hot water	0
Total	7
Total cost for the day	20

At the end of the investigation Subject K had gained 8.4 pounds and showed a corresponding increase in anthropometric measurements. Judged by the results of an examination, there was no change in his general health or physical condition. He passed his final examinations with a clean record of A's, which indicates a scholarship far above that of the average student.

It appears, then, that this subject, the best developed and most robust looking of all the men studied, judging by the data recorded, lived on the lowest diet (50.8 grams of digestible protein and 1,847 calories of available energy per day on an average) and performed a highly creditable year's work without signs of physical deterioration.

The amounts of protein and energy supplied by the diet of this subject are very small. The low protein would be understandable if the supply of energy was correspondingly large. The value for energy is, however, so low that it seems not unlikely that owing to an oversight or misunderstanding some articles were omitted in recording the daily diet.

In experiments with the respiration calorimeter made by Atwater and his associates, it has been found that subjects who were performing almost no external muscular work expended as much energy per day as Subject K received from his diet on an average, and when their muscular activity was increased their output of energy was correspondingly larger. In other words, they required as much energy for the simple processes of living as was supplied by the recorded diet of this subject, who had considerable muscular exercise in connection with his usual daily occupations. It is difficult to believe, in the light of the law of the conservation of energy, that he could have subsisted on such a diet without some drain on his body, and certainly it can not be supposed that he could continue to draw upon his body throughout the college year without some effect upon it.

DISCUSSION OF RESULTS.

METHOD OF COMPUTING THE DIETARIES.

The practical impossibility of weighing and sampling all the cooked food on its way to the subjects, under conditions existing at Randall Hall, led to a method of making dietary studies different from that generally followed. As stated earlier (p. 5), records were kept of the number and kind of the portions of food served to each subject. The amount of food in each portion was estimated by weighing sample portions and finding an average value from these weighings, which was used to calculate the weight of the portions actually served to the men. This may be called the method of average weights, inasmuch as it rests upon the assumption that the weights of successive portions of any given cooked food, on account of accidental variations, swing around an ideal value, which can be determined by weighing a sufficient number of the portions and averaging the figures so obtained. That this is the case within certain limits of error was shown by the agreement between weighings of consecutive portions of any given article of food. This is nothing more than is to be expected where the same sized dishes and serving spoons are used day after day for serving the same foods For example, to obtain the average weight of an order of white bread, nine portions were weighed as they came from the serving room on different days, with the following results: 66, 56, 63, 69, 64, 70, 62, 63, and 66 grams, the average being 64.3 grams. While the difference between the extremes is appreciable, the average variation from this average is only 3 grams, or 4.7 per cent.

The average variation of the successive weights from the average of all the weights, when reduced to a percentage basis, as in the above sample, may be called "percentage variation." The figure expressing the percentage variation is useful to indicate the degree of uniformity in the successive weights of the same article of food and furnishes an approximate measure of the accuracy of the method of averages which lies at the bottom of the whole investigation. The precise meaning of the percentage variation figure is clear from the following considerations: Let us suppose that the average weight of all the orders of bread eaten by a certain student during three weeks, determined by the actual weighing of each order, is found to be 100 grams. Suppose, also, that the average variation of the single orders from 100 grams is 4.7 grams; then the percentage variation is 4.7. This working average, as it may be termed, determined by a comparatively small number of observations, may or may not be 100 grams, the true average. For example, it may happen that the weights of the orders that we select for weighing are all above the true average or all below, instead of some above and some below. In the first instance the working average would be 104.7 grams, on the assumption that the specimen orders were dished out with the same uniformity that obtained when the true average was determined. In other words, the maximum error that the method is likely to introduce is 4.7 per cent of the total weight of the bread consumed.

Consider now the uniformity shown by other articles of food. For the important class of breadstuffs the percentage variation was found to be 7.6, for cereals it was 6.6, and for dairy products 6.6. Meats showed the greatest irregularities, the percentage variation being 13.5. Averaging the percentage variations of all the important articles gives 8.6—that is to say, if the same number of orders of all the various dishes were consumed, and we estimate the total weights by multiplying the average weight of each order by the number of orders eaten, the greatest error that lack of uniformity in the individual weights could reasonably be expected to introduce would be about 9 per cent of the total weight sought.

It does not follow, however, that the largest error to be expected in the final figures for protein and energy is 9 per cent, for all the articles of food are not of equal importance in the result. Evidently, if a subject eats but one or two orders of meat during a period, the addition to his average daily ration is small, and the error is slight if the item is left out altogether, hence it suffices to determine the nutrients and weight of the meat approximately. Similarly, in a ration consisting of meat and fruit in equal weights, it is unnecessary to determine either the weight of the fruit or its proportion of nutrients with the same accuracy as in the case of meat, since the low value of the fruit in terms of protein and energy makes its effect on the total value of the ration slight. It is clear, then, that the exactitude with which we should know the weights of the various servings or portions of the different foods depends both upon the chemical composition of the food and upon the number of orders eaten. Since we know the amounts of protein and energy furnished by the various classes of food, viz, soups, dairy products, cereals, breads, vegetables, meats, etc., and the percentage variation applying to each class, it is quite possible to compute, approximately at least, the effect produced by these variations in the final figures expressing the energy and protein in the average ration. The following table shows the amounts of nutrients furnished by the different classes of food during the whole study, the percentage variations, and the effects on the totals:

Table 13.—*Proportion of protein and energy in average daily ration per man (for the entire investigation) furnished by various classes of food and probable maximum error introduced by variation in the size of consecutive orders of the various dishes.*

Classes of food.	Average variation in weights of individual portions.	Digestible protein furnished.	Probable maximum error in protein.	Available energy furnished.	Probable maximum error in energy.
	Per cent.	*Grams.*	*Grams.*	*Calories.*	*Calories.*
Soup	7.4	1.3	0.10	21.2	1.6
Hash, fish, meats	13.5	13.1	1.77	151.4	20.4
Dairy products	6.6	9.9	.65	370.8	24.5
Breakfast cereals	6.6	4.4	.29	151.2	10.0
Breads and crackers	7.6	21.6	1.64	780.2	59.2
Desserts	7.4	3.2	.24	212.9	15.7
Vegetables	9.2	4.2	.39	193.9	17.8
Fruits	11.8	.7	.08	59.5	7.0
Beverages	7.0	1.4	.10	44.2	3.1
Combination meals	8.0	15.2	1.22	459.0	36.7
Sugars	5.0	....	....	222.1	11.1
Eggs	7.2	3.1	.22	53.7	3.9
Total	....	78.1	6.70	2,720.1	211.0

Multiplying the total probable maximum error in protein, 6.70 grams, by 100, and dividing by the total digestible protein furnished, 78.1 grams, gives 8.6 per cent as the average variation for digestible protein; a similar computation gives 7.8 per cent as the average variation for available energy; and the average of both is 8.2 per cent. This figure is believed to be the largest error that abnormal variations in the size of orders is likely to introduce into the dietaries. In the opinion of the writer, the actual error lies considerably below this, being perhaps 3 or 4 per cent. A carefully conducted dietary study where the method of weighing, sampling, and analyzing all food on hand at the beginning, received during, and remaining at the end of the period of examination is employed would probably yield results within about 1 per cent of the actual amount of nitrogen and energy in the food. The error inherent in the analytical determination of nitrogen and heat of combustion is so small that it may be neglected; but when one computes "protein" from the total nitrogen by using factors, another and sometimes considerable error may be introduced, because of uncertainty regarding the nitrogen factor for protein.[a] The use of "coefficients of digestibility" moreover is attended with uncertainty for, while they yield reasonably accurate results in the average of a considerable number of studies, the actual error in some individual results has been found to be as high as 5 per cent in one or more nutrients.[b] The method of average weights which it was necessary to employ appears, therefore, to give results that are somewhat less accurate than the usual methods, but it is believed that the results are nevertheless sufficiently exact to be trustworthy and of practical value.

Another source of error in dietary work lies in the failure to obtain representative samples for analysis. In this investigation the unusually large variety of foods eaten by the various men made it practically impossible to sample and analyze every article; on the other hand, it should be pointed out that many of the materials were consumed to such a limited extent that, as far as the effect on the results is concerned, they might be estimated with ample accuracy from available data, or, indeed, neglected altogether without materially changing the final results. With a knowledge of the number of orders of each food eaten during the periods of study, it was possible to judge whether any given article was of sufficient importance to demand analysis. Table 1, page 6, gives the percentage of protein and energy per gram of the foods used during the dietary studies, including those analyzed in connection with these studies and those for which such figures were estimated from previous analyses. There is no way of learning precisely how nearly the figures obtained by our method of sampling, analysis, and estimation represent the true values of protein and energy for the amount of food involved. The writer is of the opinion that, although the sampling, etc., in this case may not have been as accurate as in the ordinary dietary study, nevertheless the error is no greater than that involved in the use of the average weights before discussed.

From the above consideration it seems reasonable to conclude that the dietaries express the daily rations of the subjects to within 3 to 4 per cent of both the protein and the energy involved.

RANDALL HALL DIETARIES COMPARED WITH THOSE OF OTHER STUDENTS.

In the discussion of the results of the individual dietaries, they have been compared with each other and with the commonly accepted standard for a man of sedentary occupation, a basis of comparison selected because it was believed that none of the subjects were occupied in such a way that they performed any considerable amount of muscular work other than that necessitated by walking to and from recitations, meals, etc.

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[a] See Atwater and Bryant, Connecticut Storrs Station Rpt. 1899, p. 76.

[b] Ibid., p. 86.

It is interesting to compare the results obtained with these students with those of studies made at other American colleges and universities and with the results of studies in professional men's families and other families. Such a comparison is made in the following table:

TABLE 14.—*Summary of results of dietary studies with students and dietary standards.*

[Quantities per man per day.]

	Cost per day.	In total food.		Digestible protein.	Available energy.
		Protein.	Energy.		
	Cents.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Students at Randall Hall:					
Subject A	32.3	85	3,108	76	2,859
Subject B	36.1	92	3,033.	84	2,795
Subject C	41.7	97	3,196	88	2,947
Subject D	42.7	67	2,789	61	2,566
Subject E	43.3	105	2,969	97	2,712
Subject F	34.3	86	3,061	77	2,824
Subject G	62.4	120	3,656	110	3,336
Subject H	37.7	82	3,062	73	2,809
Subject I	28.7	71	2,739	63	2,506
Subject K	20.1	58	2,024	51	1,847
Average of all	37.9	86	2,964	78	2,720
Average of all except Subject K	39.9	89	3,068	81	2,817
Students at college commons, Wesleyan University:					
Subject No. 1	32.1	139	....	126	4,188
Subject No. 2	32.1	91	....	82	2,924
Subject No. 3	32.1	104	....	95	2,992
Average	32.1	111	....	101	3,368
Student boarding himself, Wesleyan University	31.6	145	....	133	3,692
Student at University of California	26.0	94	....	87	2,581
College boarding clubs:					
Men—					
At Wesleyan University, average 2 studies	....	98	....	90	3,387
At University of Tennessee, average 5 studies.	17.0	93	....	85	3,437
At University of Missouri, average 2 studies	....	96	....	88	3,450
At Maine State College, average 5 studies	28.0	121	....	112	4,128
At Western Reserve University	25.5	140	....	128	3,633
Average 15 studies	....	110	....	101	3,607
Men and women—					
At Storrs (Conn.) Agricultural School	....	104	....	96	3,564
Women[a]—					
At Wesleyan University	....	84	....	78	2,531
At North Dakota Agricultural College	13.0	64	....	59	2,579
At Lake Erie College	18.0	68	....	62	2,610
At Chicago University	25.0	108	....	99	2,866
At Western Reserve University	25.0	103	....	94	2,970
Average	....	85	....	79	2,711
Average of 14 professional men's families	28.0	104	....	96	3,221
Average of 14 mechanics' families	19.0	103	....	95	3,355
Average of 10 farmers' families	....	97	....	89	3,413
Men at rest in respiration calorimeter	....	109	....	103	2,418
DIETARY STANDARDS (ATWATER).					
Man with moderately active muscular work	....	125	....	115	3,400
Man with light to moderate muscular work	....	112	....	103	3,050
Man with sedentary occupation	....	100	....	92	2,700
Man with very little physical exercise	....	90	....	83	2,450

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[a] Quantities per woman per day. The corresponding amounts per man per day would be one-fourth greater, on the assumption that a woman eats 0.8 as much as a man under like conditions.

These comparisons afford an interesting illustration of the value of a knowledge of the relation between the cost and the actual nutritive value of food. This may be especially emphasized by a comparison of the average of the results for the Harvard students with those for the student at Wesleyan boarding himself. The latter had a clear idea of the nutritive value of different food materials and made his purchases accordingly. The cost of his diet was only about five-sixths of the average for the Harvard students, yet he obtained about seven-tenths more protein and a third more energy than they.

Some part of the larger average cost of the diet of the Harvard students is, of course, due to the operating expenses of the boarding club, which the Wesleyan student did not have to meet. The latter bought mostly food ready to eat and prepared his own meals. But even assuming that the difference was wholly due to such causes, the Wesleyan student could have obtained a diet equivalent in nutritive value to that of the average for the Harvard students for about 25 cents per day.

A comparison with other results given in the table is also interesting. In the studies with the three students boarding at the Wesleyan commons the diet ranged from 82 to 126 grams of digestible protein, and from 2,924 to 4,188 calories of energy, the average being 101 grams and 3,368 calories, which was appreciably larger than the average consumption for the Harvard students. This was true also in the case of the average of the results of 15 studies made with college boarding clubs in different parts of the country.

The above summary of the results of the studies at Randall Hall very plainly shows the wide difference in cost and nutritive value of the diet selected by the different students. The largest sum per man per day was that for Student G—namely, 62.7 cents—and the diet also supplied the largest amount of protein and energy; the smallest cost was that for Student K, and likewise the quantity of protein and energy in the diet was smaller than in that of any of the other subjects. On the other hand, the latter student, for a little less than one-third the cost, obtained very nearly one-half as much protein and considerably more than half as much energy as the former.

Subject F spent 2 cents per day more than Subject A for a diet practically the same in nutritive value. Subject A spent 5 cents per day less than subject H for a diet furnishing more protein and energy than that of the latter. Subject E spent only 0.4 cent more than Subject D, yet he obtained more energy and very much more protein in his diet than the latter: in fact Subject D spent more than twice as much as Subject K, who spent the least of all for food, yet he obtained only a little over a sixth more protein and a third more energy. It is evident from such comparisons that some of the students could have obtained considerably more actual nourishment than they did for the same expenditure, or they could have had a diet equally as nutritious as the one they had for a smaller cost.

FOOD SUPPLY IN RELATION TO BODY WEIGHT.

In considering the nutrients supplied by a given ration and the adequacy of the diet, as compared with the accepted standard, it is interesting to make comparisons on the basis of nutrients supplied per kilogram of body weight—that is, in relation to the size of the subjects, since it seems obvious that a very small man would not have the same food requirements as a large one. It has been estimated that on an average the American man weighs not far from 150 pounds (68 kilograms). The commonly accepted dietary standard for an average man at sedentary employment (92 grams digestible protein and 2,700 calories of available energy) would, therefore, provide 1.4 grams protein and 40 calories of energy per kilogram body weight. The table below shows the amounts of digestible protein and available energy furnished per kilogram body weight by the dietaries reported in this bulletin and compares these values with the standard selected:

Table 15.—*Daily income of digestible protein and available energy per kilogram body weight.*

	Average weight.	Amounts per day.		Amounts per kilogram body weight.	
		Protein.	Energy.	Protein.	Energy.
	Kilograms.	*Grams.*	*Calories.*	*Grams.*	*Calories.*
Subject A	50.2	76.2	2,859	1.5	57
Subject B	60.7	83.9	2,795	1.4	46
Subject C	65.2	87.7	2,947	1.3	45
Subject D	54.5	61.5	2,566	1.1	47
Subject E	62.6	97.1	2,712	1.6	43
Subject F	54.9	77.2	2,824	1.4	51
Subject G	66.4	110.4	3,336	1.7	50
Subject H	59.3	73.0	2,809	1.2	47
Subject I[a]	53.8	63.5	2,506	1.2	47
Subject K	70.4	50.8	1,847	.7	21
Average of all	59.8	78.1	2,720	1.3	45
Average of all except Subject K	58.6	81.2	2,817	1.4	48
Man with sedentary occupation	68.0	92.0	2,700	1.4	40

[a] This student's ration was much larger in the second and third periods than in the first. If the average of the last two periods be taken as nearer normal, the income would be, per kilogram, protein 1.4 grams, energy 53 calories.

It will be seen that considering the average results for all the students the food furnished 1.3 grams digestible protein and 45 calories of available energy per kilogram body weight, or 7 per cent less protein and 12 per cent more energy than is called for by the standard selected for comparison. If the results obtained with Subject K, which there is some reason for considering exceptional, are omitted, the average amounts would be 1.4 grams digestible protein and 48 calories available energy, or as much protein and 20 per cent more energy than the standard calls for.

Considering the individual studies it will be noted that, with the exception of Subject K, the amount of energy was in all cases greater than the standard, while that of protein equaled or exceeded it in five cases. Judging the results of the studies in accordance with this method of comparison, the amounts of protein and energy obtained were on an average sufficient to maintain the subjects in equilibrium with their environment.

THE STRENGTH TESTS.

At the beginning and end of each period of examination the subjects reported for strength tests, as has been noted. The system was that devised by Dr. D. A. Sargent and now used in many colleges. The individual taking the test is measured with a tape line and calipers. He is then made to exert his strength upon a series of spring dynamometers, the compression of which measures the strength of the various muscles. The results obtained are tabulated and, by comparison with a set of average results for men of the same age, the individual development may be deduced.

In the case of the men examined in this investigation the changes observed were very small for the most part and are within the limit of probable error in the method. A few of the more significant measurements are given in the following table:

Table 16.—*Ages and physical measurements of subjects.*

	Age.	Height.	Chest.	Waist.	Thigh.	Weight.	Strength.
	Years.	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Kgm.*	*Kgm.*
Subject A:							
Beginning	31	157.0	84	69	46.5	48.5	427
End		157.0	89	72	50.5	51.9	539
Gain		.0	5	3	4.0	3.4	112
Subject B:							
Beginning	20	161.5	85	74	52.0	59.8	698
End		162.0	89	73	54.5	61.7	767
Gain		.5	4	− 1	2.5	1.9	69
Subject C:							
Beginning	23	167.5	85	76	55.5	65.7	526
End		168.5	88	76	56.0	64.8	809
Gain		1.0	3	0	.5	− .9	283
Subject D:							
Beginning	22	168.5	82	67	49.5	54.2	560
End		168.5	84	69	49.0	54.7	699
Gain		.0	2	2	− .5	.5	139
Subject E:							
Beginning	26	166.5	90	75	51.5	61.8	637
End		166.5	94	76	53.5	63.5	743
Gain		.0	4	1	2.0	1.7	106
Subject F:							
Beginning	25	162.0	86	68	49.5	54.5	682
End		163.5	88	71	50.0	55.3	900
Gain		1.5	2	3	.5	.8	218
Subject G:							
Beginning	22	174.0	88	72	53.0	65.0	618
End		174.5	90	74	55.5	67.8	824
Gain		.5	2	2	2.5	2.8	206

TABLE 16.—*Ages and physical measurements of subjects*—Continued.

	Age.	Height.	Chest.	Waist.	Thigh.	Weight.	Strength.
	Years.	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Kgm.*	*Kgm.*
Subject H:							
Beginning	27	179.0	84	70	47.5	58.2	607
End		181.0	88	70	49.5	60.4	735
Gain		2.0	4	0	2.0	2.2	128
Subject I:							
Beginning	16	163.0	84	67	45.5	50.0	740
End		164.0	88	74	49.5	57.6	890
Gain		1.0	4	7	4.0	7.6	150
Subject K:							
Beginning	22	170.0	98	77	54.5	68.5	682
End		170.0	98	82	58.1	72.3	793
Gain		.0	0	5	3.6	3.8	111
Average	23.4	167.0	87.0	71.5	50.5	58.6	618
Average gain		.6	2.7	2.2	2.1	2.4	152
Per cent of average gain.		.4	3.1	3.1	4.2	4.1	24.6

The gain in weight, averaging about 4 per cent, is the most significant point brought out by the table. Every subject but one (Subject C) showed a slight, but tolerably uniform, gain in weight throughout the year. As was to be expected, all the other measurements also increased more or less. In the case of the older of the men, i. e., those who had attained their full physical development, the gain in weight indicated that their diet was a little more than sufficient to maintain them in equilibrium with their environment. With the younger men it is a question whether their gain was more or less than normal growth demands; or, in other words, whether their diet was sufficient to maintain them in equilibrium with their daily work and also to supply the needs of bodies still growing and developing. It is impossible to answer this question from the data of this study, but it is clear that in every case but one (Subject C) the amount of nutritive material obtained was at least not too small to allow of a slight increase in the body weight.

The element of skill in applying one's power to the dynamometers influences results to an unknown extent, and the same individual after several successive trials often increases his previous records by several hundred points. The increase of about 25 per cent in the strength, as shown by the figures, can hardly be regarded as a reliable indication of actual gain in muscular strength, since it seems too small to lie outside the improvement arising from a mere repetition of trials.

The strength records of the subjects are rather lower than the general average of such tests with students at Harvard. The physical measurements recorded also show that the men included in the investigation were below the average. For example, as regards height, these men, on the average, would stand about twenty-fourth if we took 100 students at random and arranged them in a row, beginning with the smallest and ending with the tallest. As regards weight, they, as an average, would stand at the thirty-fourth place, beginning with the lightest; in girth of chest, they would take forty-eighth place; in girth of waist, forty-third place, and in girth of thigh, forty-sixth place. Taking all measurements into account, they would stand at about the fortieth place.

GENERAL PHYSICAL CONDITION OF THE SUBJECTS.

At the time of the strength tests the men were given a medical examination by Dr. E. A. Darling somewhat resembling in character that required of applicants for life insurance. It was thought that such examinations, made by a physician, would bring to light any changes that would occur in the general health of the men—changes which the strength tests of course fail to indicate.

The general condition of the men as a whole at the beginning of the study was regarded as rather below par. Only two (Subjects I and K) of the ten were classed as well developed and nourished, six (B, C, E, F, G, and H) were in fair condition, and two (A and D) were poorly developed and nourished. None was actually in poor health, though one man had recently recovered from typhoid fever. During the period of study several of the men had slight illnesses, such as indigestion, etc., but nothing which affected their general condition to any great extent. At the time of the last examination most of the men declared that they felt better than at the first. Physical examination, however, showed no noticeable change except a slight increase of fat in several instances. There seemed certainly no deterioration.

Data recorded by the subjects themselves in regard to daily habits and occupations are summarized in the following table:

TABLE 17.—*Approximate daily programme of the different subjects.*

Subject.	Sleep.			Exercise.		
	Period 1.	Period 2.	Period 3.	Period 1.	Period 2.	Period 3.
	Hours.	*Hours.*	*Hours.*			
A	7½	8¾	7¾	Gymnasium ½ hour, or walking ½ to 2 hours, daily.	Gymnasium ½ hour, or walking ½ to 2 hours, daily.	Gymnasium ½ hour, or walking ½ to 2 hours, or bicycle ½ to 1 hour, daily.
B	7½	7¾	7½	Walking 1 hour (5 days), football (5 days).	Walking ½ to 1 hour, 9 days.	Baseball ½ to 2 hours, 10 days.
C..........	7	7	7	Walking 3 hours (Sundays only).	Walking 2 hours (Sundays only).	Bicycle 1 hour, 11 days.
D	6½	7¼	7	Gymnasium ½ to 1 hour, 9 days.	None	None.
E	7¾	7¾	8	Walking 2½ to 3 miles, daily.	Walking 2½ to 3 miles, daily.	Walking 2½ to 3 miles, daily.
F..........	8½	8	8	Walking or gymnasium ½ to 1 hour, daily.	Walking or gymnasium ½ to 1 hour, daily.	Walking or handball ¾ to 1½ hours, 7 days.
G	6¾	6¾	6½	Walking 1 to 2 hours, 2 days; skating ¾ hour, 1 day.	None	None.
H	8	7¾	7¾	Walking or bicycle ½ to 1 hour, 7 days.	Walking or gymnasium 1 hour, 10 days.	Bicycle ½ to 2 hours, 6 days.
I..........	8¼	8½	8¼	Walking 4 hours, 1 day.	Walking ½ to 1 hour, 2 days.	Walking 1 hour, 1 day; bicycle 5 hours, 1 day.
K	7	6¾	6¾	None	Walking 1 hour, 1 day.	None.

TABLE 17.—*Approximate daily programme of the different subjects*—Continued.

Subject.	College work—lectures, reading, etc.			Outside work.		
	Period 1.	Period 2.	Period 3.	Period 1.	Period 2.	Period 3.
	Hours.	*Hours.*	*Hours.*			
A	10	8	9	None	None	None.
B	8½	7½	8	Barber's shop 8 hours, 3 days.	Barber's shop, 8 hours, 1 day; waiting on table at Randall 1 to 2 hours, 9 days.	None.
C	10¾	12½	11	Waiting on table at Randall Hall 1 to 3 hours, daily.	Waiting on table at Randall Hall 1 to 3 hours, daily.	Waiting on table at Randall Hall 1 to 3 hours, 17 days.
D	12¾	11½	12½	None	None	None.
E	9½	7¼	6½	None	None	None.
F	7	7½	7	None	None	None.
G	9	9¾	9¼	None	None	None.
H	8¼	7	7¾	Waiting on table at Randall Hall ¾ to 1½ hours, 10 days.	Waiting on table at Randall Hall ¾ to 1½ hours, 13 days.	Waiting on table at Randall Hall ¾ to 1½ hours, 12 days.
I	7½	8	8¾	Clerical work 3 to 5 hours, 9 days.	Clerical work 1½ to 4 hours, 6 days.	Clerical work 1 to 2½ hours, 4 days.
K	11¼	10	10½	Waiting on table at Randall Hall 1½ to 3 hours, 16 days.	Waiting on table at Randall Hall 1 to 4 hours, 17 days.	Waiting on table at Randall Hall 2½ to 4½ hours, daily.

The data recorded show that all the men spent a fair amount and some an unusually large proportion of time on their college work. All spent very little time, on the average, in exercise beyond that necessary for walking to and from lectures and meals, and, as a rule, indulged only in the lighter forms, such as walking and gymnasium work, with occasionally bicycling, baseball, and handball. The average time spent in sleep was somewhat less than is usual among college men.

Briefly, then, according to Doctor Darling's report, it may be said that (1) no appreciable change was observed in the general condition of the men during the period of observation; (2) the men spent rather less time than the average in sleep and exercise, but rather more than the average in the college work; and (3) the dietary was apparently sufficient to maintain the nutritive standard to which they were accustomed.

MENTAL WORK OF THE SUBJECTS.

A year's work for a man in regular standing at Harvard University consists of seldom less than four or more than six whole (i. e., lasting throughout the year) courses of study. The highest grade of marks given is "A," which indicates exceptionally good work. The grade "B" indicates work above the average, "C" is given for average work, and the grade "D" indicates that the student has "passed," but without credit.

As shown in the preceding table, five of the men engaged in no systematic mental work aside from that involved in their regular college courses. In these instances the grades or marks received by the men in their courses of study are a tolerably accurate measure of their mental work. In the case of the men who did outside work the grades attained by them in their college courses are, of course, only an approximate indication of the amount of mental work. The following table shows the number of courses taken and the average grades attained by each subject for the year:

TABLE 18.—*Scholarship of the subjects as shown by the number of courses of study taken and the average grades attained throughout the year.*

Subject.	Kind of work.	Number of courses.	Average grade.	Remarks.
A	Mathematics	4	A	No outside work. First year student in graduate school.
B	History and languages.	5	(a)	Worked in barber shop and was waiter at Randall Hall. Freshman in the college.
C	General scientific.	6	(a)	Served as a waiter at Randall Hall and did clerical work. Was a sophomore in the college.
D	Mathematics and physics.	4	B	No outside work. Sophomore in the college.
E	Electrical engineering.	7	B	No outside work. Senior in the Lawrence Scientific School.
F	Greek, Latin, and classical philology.	4	A	No outside work. Second year student in graduate school.
G	General classic	5	(a)	No outside work. Senior in college.
H	History, philosophy, economics, etc.	4	B	Served as waiter at Randall Hall. Senior in the college.
I	General classic	6	B	Did clerical work. Freshman in college.
K	Greek	4½	A	Served as waiter at Randall Hall. Senior in the college.

a Between B and C.

A glance at the table shows that on the whole the work of these men in their college courses was of a very high grade; in fact, far above the average. Moreover, the studies pursued were, with some exceptions, of an advanced nature.

CONCLUSIONS.

The general trend of the results of these studies is clear. The ten young men performing approximately the same duties under the same general conditions lived on diets that differed widely in respect to the amounts of protein and energy supplied. The differences were noticeable not only with the different individuals, but also, in some cases, with the same individual in different periods. So far as it is possible to judge, the men appeared to be in bodily equilibrium on their various diets during the different periods; at least they showed no change in general physical condition that could be detected by careful medical examination.

In discussing the results of the investigations, especially with reference to the adequacy of the diet for daily needs, it has been assumed that the occupation of the subjects may be considered sedentary. A number of the men took more or less exercise and had some work other than that connected with their college duties, yet it seems fair to conclude that the daily lives of all the men should be called sedentary because none of them apparently had as much exercise as mechanics and others engaged in various forms of muscular work, who are included in the group covered by the term "light to moderate muscular work." For all the subjects together the average daily consumption of digestible protein was 78 grams and the available energy of the food 2,720 calories, whereas the standard with which comparison has been made—namely, that for a man with sedentary occupation—suggests 92 grams digestible protein and 2,700 calories of available energy. In other words, as shown by this comparison, the average amount of digestible protein of the daily diet was less than the standard selected calls for, while the amount of available energy was about the same.

It is interesting, however, to consider the amount of digestible protein and available energy supplied by the food in comparison with the weights of the subjects. Assuming that the average American man weighs not far from 150 pounds (68 kilograms), the commonly accepted dietary standard for the average man at sedentary employment would, therefore, provide 1.4 grams protein and 40 calories of energy per kilogram body weight. As shown by the average results of all the students, the food furnished 1.3 grams digestible protein and 45 calories of energy per kilogram body weight, or 7 per cent less protein and 12 per cent more energy than is called for by the standard selected for comparison. In the case of the individual studies with one exception the amount of energy provided was greater than the standard calls for, while with five of the subjects the amount of protein equaled or exceeded the standard and with four it was only a little below it. It will be seen that when the comparison is made on the basis of actual weight of the subjects the agreement with the dietary standard is closer than on the basis of amounts per person per day.

As has been stated, marked differences were observed in the amounts consumed by the different individuals and by the same individual in different periods, yet on the whole the subjects appeared to be in equilibrium with their environment. The question naturally arises then, what would be a suitable dietary standard for these men, since in some cases there appears to have been for a given subject not one ration only but several different rations which enabled him to do his customary work without apparent change in physical condition? It seems reasonably certain that as regards protein the daily requirement is not a fixed quantity either for different individuals under similar circumstances or for the same individual at all times. So far as any given individual is concerned, it is known that the quantity of protein may vary within rather wide limits and that the body seems capable of adapting itself under certain conditions to diets of markedly different character. When such facts are considered the variations in the amounts of protein in the diets of the different subjects or with the same subject in different periods are not surprising.

It is quite generally conceded that the dietary standards commonly accepted suggest amounts which experience has shown to be ample under usual circumstances for nourishing the body, maintaining it in harmony with its environment, and keeping up its resistance to any unfavorable conditions which may arise. It is recognized that in the case of individuals and groups variations from any such standard will always be found. The variations from the dietary standard observed in the case of these students are interesting, but are, of course, not uniform or numerous enough to warrant any modification of the standard. If average values per person are considered, it will be seen that the protein supplied was lower and the energy somewhat higher than the quantities called for by the standard, a variation which is in harmony with the commonly accepted theory that within limits a deficiency of protein may be compensated by an increase of energy. When the comparison is based on amounts per kilogram body weight the agreement with the dietary standards is fairly close in the case of protein, whereas the energy exceeds the standard.

As shown by the average results of studies made at a number of American colleges and universities, the diet of the group studied at Harvard furnished considerably less protein and energy than usual. The results reported in the present investigation are obviously too few for sweeping deductions, and probably no one would suggest that the diet of the average student is too large, because the students here studied lived on a diet furnishing smaller amounts of protein and energy. Nature is very accommodating, and there is apparently always an effort to bring the body into harmony with its environment in respect to food and other conditions. In the case of these students and others studied elsewhere there is no means of knowing the effect of the diet on their future health and well-being, or on their subsequent resistance to disease, or other conditions which would make unusual demands on their physical vigor. Such questions must be taken into account before final conclusions can be reached.

O

LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON THE FOOD AND NUTRITION OF MAN—Continued.

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CIRCULAR.

Circ. 46. The Functions and Uses of Food. By C. F. Langworthy. Pp. 10.

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MISCELLANEOUS.

Investigations on the Nutrition of Man in the United States. By C. F. Langworthy and R. D. Milner. Pp. 20.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 153.

A. C. TRUE, Director.

PROCEEDINGS

OF THE

EIGHTEENTH ANNUAL CONVENTION

OF THE

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS,

HELD AT

DES MOINES, IOWA, NOVEMBER 1-3, 1904.

EDITED BY

A. C. TRUE and W. H. BEAL, for the Office of Experiment Stations,

AND

H. C. WHITE, for the Executive Committee of the Association.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

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[a] President.

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[c] Chancellor.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 153.

A. C. TRUE, Director.

PROCEEDINGS

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ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS,

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EDITED BY

A. C. TRUE and W. H. BEAL, for the Office of Experiment Stations,

AND

H. C. WHITE, for the Executive Committee of the Association.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., March 15, 1905.

Sir: I have the honor to transmit herewith for publication Bulletin No. 153 of this Office, containing the proceedings of the Eighteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Des Moines, Iowa, November 1–3, 1904.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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[a] Now Assistant Secretary U. S. Department of Agriculture.

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Maine: G. E. Fellows, C. D. Woods.

Maryland: J. R. Owens, H. J. Patterson.

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Mississippi: J. C. Hardy.

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Oregon: A. L. Knisely.

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Government Board, Louisiana Purchase Exposition: W. V. Cox.
Ottawa, Canada: W. Saunders.
Santiago de las Vegas, Cuba: N. S. Mayo.

CONSTITUTION OF THE ASSOCIATION.

NAME.

This association shall be called the Association of American Agricultural Colleges and Experiment Stations.

OBJECT.

The object of this association shall be the consideration and discussion of all questions pertaining to the successful progress and administration of the colleges and stations included in the association, and to secure to that end mutual cooperation.

MEMBERSHIP.

(1) Every college established under the act of Congress approved July 2, 1862, or receiving the benefits of the act of Congress approved August 30, 1890, and every agricultural experiment station established under State or Congressional authority, the Bureau of Education of the Department of the Interior, the Department of Agriculture, and the Office of Experiment Stations of the last-named Department, shall be eligible to membership in this association.

(2) Any institution a member of the association in full standing may send any number of delegates to the meetings of the association. The same delegate may represent both a college and a station, but shall vote in only one section and shall cast only one vote in general sessions. Other delegates may be designated by any institution to represent it in specified divisions of the sections of the association, but such delegates shall vote only in such divisions, and no institution shall be allowed more than one vote in any sectional meeting.

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the association, with all privileges except the right to vote.

(4) In like mannner, any person engaged or directly interested in agriculture or mechanic arts who shall attend any convention of this association may be admitted to similar privileges.

SECTIONS.

(1) The association shall be divided into two sections: (a) A section on college work and administration, (b) a section on experiment station work.

The section on college work and administration shall be composed of the presidents or acting presidents of colleges and universities represented in the association, or other representatives of such institutions duly and specifically accredited to this section, and no action on public and administrative questions shall be final without the assent of this section.

The section on experiment station work shall be composed of the directors or acting directors of experiment stations represented in the association, or of other representatives of such stations duly and specifically accredited to this section.

(2) Members of these two sections (and no others) shall be entitled to vote both in general sessions and in the section to which they respectively belong.

The representative appointed by the U. S. Bureau of Education shall be assigned to the section on college work and administration; the representative of the Office of Experiment Stations to the section on experiment station work; and the representative of the U. S. Department of Agriculture to either section as he may elect and the section by vote authorize; but such election once made and authorized may not be changed during the sessions of a given convention.

Each section may create such divisions as it may from time to time find desirable, and shall elect its own chairman and secretary for sectional meetings, whose names shall be reported to the association for record.

(3) Each section shall conduct its own proceedings, and shall keep a record of the same, and no action of a section, by resolution or otherwise, shall be valid until the same shall have been ratified by the association in general session and, in the case provided for in the foregoing paragraph (1), shall also have been approved by the section on college work and administration.

MEETINGS.

(1) This association shall hold at least one meeting in every calendar year, to be designated as the annual convention of the association. Special meetings may be held at other times, upon the call of the executive committee, for purposes to be specified in the call.

(2) The annual convention of the association shall comprise general sessions and meetings of the sections and provision shall be made therefor in the programme. Unless otherwise determined by vote, the association will meet in general session in the forenoons and evenings of the convention and the sections in the afternoons.

OFFICERS.

(1) The general officers of this association, to be chosen annually, shall be a president, five vice-presidents, a bibliographer, and a secretary, who shall also be treasurer; and an executive committee of five members, three of whom shall be chosen by the section on college work and administration and two by the section on experiment station work: *Provided, however,* That a member chosen by either section need not be a member of that section. The executive committee shall choose its own chairman.

(2) Each section shall, by ballot, nominate to the association in general session for its action, a chairman and a secretary for such section.

(3) The president, vice-presidents, secretary, and bibliographer of this association shall be elected by ballot upon nomination made upon the floor of the convention, and shall hold office from the close of the convention at which they are elected until their successors shall be chosen.

(4) Any person being an accredited delegate to an annual meeting of the association, or an officer of an institution which is a member of the association in full standing at the time of election, shall be eligible to office.

DUTIES OF OFFICERS.

(1) The officers of the association shall perform the duties which usually devolve upon their respective offices.

(2) The president shall deliver an address at the annual convention before the association in general session.

(3) The executive committee shall determine the time and place of the annual conventions and other meetings of the association, and shall, between such conventions and meetings, act for the association in all matters of business. It shall

issue its call for the annual conventions of the association not less than sixty days before the date on which they are to be held and, for special meetings, not less than ten days before such date. It shall be charged with the general arrangements and conduct of all meetings called by it. It shall designate the time and place of the convention; it shall present a well-prepared order of business—of subjects for discussion—and shall provide and arrange for the meetings of the several sections. The subjects provided for consideration by each section at any convention of the association shall concentrate the deliberations of the sections upon not more than two lines of discussion, which lines as far as possible shall be related. Not more than one-third of the working time of any annual convention of the association shall be confined to miscellaneous business.

FINANCES.

At every annual convention the association, in general session, shall provide for obtaining the funds necessary for its legitimate expenses, and may, by appropriate action, call for contributions upon the several institutions eligible to membership; and no institution shall be entitled to representation or participation in the benefits of the association unless such institution shall have made the designated contribution for the year previous to that in and for which such question of privilege shall arise, or shall have said payment remitted by the unanimous vote of the executive committee.

AMENDMENTS.

This constitution may be amended at any regular convention of the association by a two-thirds vote of the delegates present, if the number constitute a quorum: *Provided*, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given at the next preceding annual convention, and repeated in the call for the convention. Every such proposition of amendment shall be subject to modification or amendment in the same manner as other propositions, and the final vote on the adoption or rejection shall be taken by yeas and nays of the institutions then and there represented.

RULES OF ORDER.

(1) The executive committee shall be charged with the order of business, subject to special action of the convention, and this committee may report at any time.

(2) All business or topics proposed for discussion and all resolutions submitted for consideration of the convention shall be read and then referred, without debate, to the executive committee, to be assigned positions on the programme.

(3) Speakers invited to open discussion shall be entitled to twenty minutes each.

(4) In general discussions the ten-minute rule shall be enforced.

(5) No speaker shall be recognized a second time on any one subject while any delegate who has not spoken thereon desires to do so.

(6) The hours of meeting and adjournment adopted with the general programme shall be closely observed, unless changed by a two-thirds vote of the delegates present.

(7) The presiding officer shall enforce the parliamentary rules usual in such assemblies and not inconsistent with the foregoing.

(8) Vacancies which may arise in the membership of standing committees by death, resignation, or separation from the association, of members, shall be filled by the committees, respectively.

PROCEEDINGS OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

MINUTES OF THE GENERAL SESSION.

MORNING SESSION, TUESDAY, NOVEMBER 1, 1904.

The convention was called to order at 10 o'clock a. m., in the banquet room of the Hotel Chamberlain, at Des Moines, Iowa, President W. O. Thompson, of Ohio, in the chair.

Prayer was offered by J. Chalmers, of South Dakota.

On motion the following persons were voted the privileges of the convention under the clause of the constitution which provides that "delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the association, with all privileges except the right to vote:" N. S. Mayo, Central Experiment Station, Cuba; H. Hayward, Mount Hermon Institute, Massachusetts; G. G. Hedgcock, Missouri Botanical Garden; L. W. Watkins, Michigan Board of Agriculture; W. V. Cox, secretary Government Board Louisiana Purchase Exposition.

RESOLUTION RELATING TO ASSOCIATION OF STATE UNIVERSITIES.

H. C. White, of Georgia, on behalf of the executive committee, offered the following resolution, and asked immediate action:

Resolved, That the Association of American Agricultural Colleges and Experiment Stations extend to the National Association of State Universities, now in session in this city, a most cordial greeting in recognition of common and mutual endeavors in the cause of learning, and in assurance of fraternal admiration and esteem.

Resolved, second, That members of the Association of State Universities be invited to seats on the floor during this convention.

The resolution was adopted, and the secretary was directed to transmit it at once.

REPORT OF THE EXECUTIVE COMMITTEE.

The report of the executive committee was presented by H. C. White, of Georgia, chairman, as follows:

Your executive committee, appointed at the seventeenth annual convention of the association, held in Washington, D. C., November 17-19, 1903, met immediately upon adjournment of the convention, and organized by the selection of President H. C. White, of Georgia, as chairman. Acting under instructions of the committee, the chairman issued and posted to each member of the association, under date of December 15, 1903, an abstract memorandum of the proceedings of the convention of 1903. The proceedings in full were edited by the chairman, and placed in the hands of the Office of Experiment Stations, U. S. Department of Agriculture, for publication, January 10, 1904.

Six subsequent meetings of the committee, at each of which a quorum was present, were held as follows: At Washington, D. C., December 18–19, January 18–20, February 19–20, March 17–19, and October 1, and at Des Moines, Iowa, October 31. Five circulars of information concerning the results of these meetings were issued and posted to members of the association. Other business was transacted by correspondence or by attention of individual members of the committee. The call for the eighteenth annual convention (1904) was issued July 1, and the programme for the convention, as arranged by the committee, October 22.

In obedience to the instructions of the association at the last annual convention, your committee continued the efforts to secure favorable action by Congress on the mining-school bill and for increasing the annual appropriation for the experiment stations. The character and results of these efforts have been in part made known to the members of the association through the circulars issued by the committee. Meeting in Washington shortly after the convening of the second session of the Fifty-eighth Congress, in December, your committee secured the consent of Mr. Mondell, of Wyoming, to reintroduce and endeavor to secure favorable action upon the bill for the endowment of schools of mines in connection with the land-grant colleges and other institutions, which had failed of consideration in the Fifty-seventh Congress. The bill was practically identical in wording with that previously introduced by General Grosvenor, which had received the indorsement of the association. The National Association of State Universities and the National Association of State Mining Schools proposed an amendment to the bill, which your committee thought inimical to the interests of the institutions represented in this associaton; but after conference between your committee and the executive committees of the other associations named the amendment was abandoned, and these organizations came cordially and actively to the support of the original bill of this association. Your committee appeared before the Committee on Mines and Mining of the House of Representatives and secured a favorable unanimous report on the bill, and it was so reported to the House and placed on the Union Calendar February 1, 1904. Guided by the wise counsels of Mr. Mondell, whose efforts in behalf of the measure were most sympathetic and energetic, your committee employed its best efforts to secure consideration for the bill, but without success. Failure we believe to be attributable mainly to the shortness of the session of Congress and a disinclination to enact legislation of this character on the eve of a Presidential election, and not to opposition to the bill on its merits. Impressed with the importance of the measure to the land-grant colleges, and having faith in ultimate success in its passage, your committee earnestly recommends continued efforts of the association in this direction.

Before the meeting of your committee Mr. Adams, of Wisconsin, had introduced in the House of Representatives a bill providing for increased appropriations to the experiment stations. After conference with Mr. Adams and the suggestion of several desirable amendments, which were accepted by him, your committee gave its hearty and active support to his bill, and aided him to the extent of its ability in furthering its progress. A favorable report was secured from the Committee on Agriculture of the House in February, but it was found impossible to secure consideration for the bill before the adjournment of Congress in March. Mr. Adams was most energetic, wise, and able in the conduct of his measure, giving, indeed, the major portion of his time and attention in Congress in its interest. He has expressed his firm conviction—which your committee shares—that an overwhelming majority was favorable to the passage of his bill could consideration for it have been secured. The bill is still pending in Congress, and as its terms are in the main quite satisfactory to our institutions your committee recommends the continuance of the support of this association. The report of failure of its efforts in connection with these important measures, and of repeated failure in case of the first, is unpleasant and, to some extent, mortifying to your committee. But when it is remembered that failures many times repeated met similar efforts in connection with the Hatch Act and the act of 1890 before these were carried to final successful issue we are encouraged to believe that similar persistence in these present cases will eventually be crowned with similar success.

Immediately after the adjournment of the last annual convention your committee called upon the honorable Secretary of Agriculture, at his request, and enjoyed a most cordial and frank conference on the subject of the cooperation between the Department of Agriculture and the agricultural experiment stations. It was known to the Secretary and to your committee that some friction had arisen in several of the States because of an overlapping of the lines of work of the Department and the stations, and the lack of cooperation and a mutual understanding necessary to preserve the interests of all concerned. It was felt that, in order that the association's standing committee on cooperation between the stations and the U. S. Department of Agriculture should be in position to advise the association from time to time, concerning the extent and character of this cooperation, a full and complete understanding between the authorities of the Department and the association should be secured. Your committee considered it within its duty to attempt to secure such understanding and a recognition of the broad and general principles which should guide such cooperation. The Secretary of Agriculture expressed his desire that conferences to that end should be freely held with the appropriate officials of the Department and designated a committee of chiefs of the bureaus of the Department, consisting of Messrs. Galloway, Whitney, and True, to confer with your executive committee with a view to arriving at a basis of cooperation mutually satisfactory. Three personal conferences of the two committees were held, characterized on the part of all concerned by cordiality, frankness, and an earnest desire to ascertain and provide for the removal of possible causes of friction in the work of the Department and of the stations. During the progress of the conferences your committee, through correspondence, solicited the views of the station workers in the several States and Territories upon the matter at issue, and a large contribution of facts and opinions in the premises is now in possession of the committee. For various reasons it has not been found possible as yet, as a result of these conferences, to reach a concrete conclusion in the matter, such, for example, as might be embodied in a code of written regulations defining the legitimate work of the Department and of the stations in common territory, but your committee is of the opinion that much has been accomplished in the direction of mutual understanding and of the establishment of a " modus vivendi " which will afford hereafter large opportunity for the association's standing committee on cooperation to advance the interest of the experiment stations through cordial and sympathetic relations with the Department of Agriculture. Your committee recommends the continuance of these conferences, understanding such to be also the pleasure of the Secretary of Agriculture.

Meanwhile, during the progress of these conferences, a rather startling incident related to the subject-matter occurred. The Committee on Agriculture of the House of Representatives, during its consideration of the agricultural appropriation act, carrying the annual appropriation to the experiment stations, inserted a clause in the act, authorizing and directing the Secretary of Agriculture to "coordinate the work of the several stations, and the work of the stations with the Department of Agriculture, to the end of preventing unnecessary duplication of work, of increasing the efficiency of the stations and the Department of Agriculture, and to unify and systematize agricultural investigation in the United States."

In the haste of disposing of necessary appropriation acts, this bill was reported and within twenty-four hours passed the House of Representatives (without a dissenting vote), and before your committee became aware of the existence of the clause referred to. Learning of its existence, your committee immediately communicated by wire with the chairman of the Senate Committee on Agriculture and received assurance that the Senate would reject or modify the clause as passed by the House. Having its own opinion of the objectionable character of the proposed legislation strengthened by numerous telegrams and letters from members of the association, your committee subsequently visited Washington and after conference with the chairmen and members of the House and Senate Committees on Agriculture, secured without difficulty a rejection of the clause by the Senate and unanimous agreement to the rejection by the conference committee of the two Houses.

This incident and the large and careful consideration given during the year to the relations of the experiment stations to the Department of Agriculture, lead your committee to report frankly to the association that, in its judgment, a grave situation has arisen, involving the entire future of agricultural research work in the United States. For many years after the establishment of the State experiment stations these were the main—almost the exclusive—

instruments through which research in agriculture in this country was prosecuted. No one conversant with the brilliant achievements of the State stations, and the beneficent influence of these upon the economic agriculture of the country, may doubt the effectiveness of the stations as agents in agricultural research. During this period the stations had a right to expect and they did receive much valuable aid from the U. S. Department of Agriculture, particularly through its ability, as a great department of the National Government, to give wide circulation to and general acquaintance with the results obtained by the stations. Within a few years past, however, a number of bureaus of purely scientific research, as related to agriculture, have arisen within the Department of Agriculture, and have been maintained by generous appropriations of money from the National Treasury. The Department has therefore entered upon—or at least been engaged in to a far greater extent than heretofore—a field of endeavor which formerly was occupied almost exclusively by the State stations.

This statement of facts is made by your committee in no spirit of complaint—certainly in no spirit of sensitiveness to rivalry. It is freely conceded that the agricultural research work of the Department of Agriculture is of high quality and value. It is as stoutly maintained that the work of the stations is at least equally so. But, with two agents operating in the same field, common prudence and regard for effectiveness dictate that care should be taken that each singly, or the two combined, should operate with maximum economy and for maximum results. Considered from the point of view of the country as a whole, and bearing in mind that the whole is but an aggregation of parts, if a particular research may, all things considered, be undertaken to the best advantage by a local station, it should be given over to the station; if by the Department, it should be given over to the Department. There would probably be no dispute of the soundness of this proposition, but there is one factor in the case which seriously disturbs the clearness of vision in discerning the relative suitabilities of the station and the Department in the premises. The Department is comparatively rich, with a readily approachable and generous Congress at its doors and the resources of the Federal Treasury at its back. The stations are comparatively poor in money, without hope, and perhaps without expectations, in equity, of large aid from their several States, widely scattered and far removed from the ear of Congressional committees. It would not be surprising, therefore, if mere possession of the financial ability to do it might lead the Department to undertake some kinds of research work which the stations are otherwise better qualified to do. There is also danger perhaps that the inability of the stations to compete with the Department in the matter of compensation offered qualified and desirable men may lower the standard or impair the enthusiasm of service at the stations in such manner as to disqualify the stations for work which otherwise, by reason of their local conditions, they should be better able to do than a single Department at the National Capital. In fine, it is conceivable that a rich and central agency of research might so overshadow poor and scattered agencies as to seriously impair their standing and efficiency. Your committee, therefore, commends to the serious consideration of the association the whole question of the relations of the State experiment stations and of the Department of Agriculture to the research work in agriculture, which must continue and increase in this country if science is to be made contributory in the fullest measure to our economic agriculture. With a view to laying in some measure a foundation for effort on the part of the association in what would seem to be an appropriate direction, and in order that a proper balance between the two great agencies of research might be preserved, your committee suggested to the chairmen of the House and Senate Committees on Agriculture, at the last session of Congress, that it might be well for the institutions represented in this association to be heard before these committees when the appropriations to the stations and to the research bureaus of the Department of Agriculture were under consideration. Both gentlemen heartily approved the suggestion, and gave it as their opinion that an expression of the views of the stations would be most acceptable and helpful to the committees. Your committee respectfully recommends that instruction be given your executive committee to make clear to the proper Congressional committees, if hearings may be secured, the important part taken by the State experiment stations in the agricultural research work of this country, with a view to securing for the stations some measure of equity in the appropriations made for this purpose from the National Treasury.

The post of Assistant Secretary of the U. S. Department of Agriculture fell vacant through the death in July last of the Hon. J. H. Brigham. Sharing the opinion expressed in numerous communications received from members of the association, that it would be of advantage to both the Department of Agriculture and the land-grant institutions were the incumbent of this office a person of scientific attainments, personally experienced in scientific work related to agriculture, or having intelligent sympathy therewith, your committee respectfully requested of the President of the United States (in whose hands the appointment lay) an opportunity to present their views in the premises. A prompt and cordial response was made to the request, and on October 1 your committee enjoyed a personal interview of most satisfactory character with the President. Refraining, as was proper, from suggesting any individual for consideration, the views of the committee were fully presented, and emphasis was laid upon the extremely satisfactory character of the services of Professor Willits and President Dabney, incumbents of the office in previous administrations, as indicative of the type of man who might with advantage be selected at the present juncture. The President granted the committee a most kind and attentive hearing and expressed his sympathetic accord with the views presented. Your committee is abundantly satisfied that, so far as other necessary considerations will permit, the President will gladly meet the wishes of the association as expressed through your committee in making this appointment.

Numerous matters of detail, concerning which no report is necessary, have received the attention of your committee during the year. Proper representations were made as directed to the Secretary of Agriculture concerning the desire of the association that the Experiment Station Record should contain, more generally, brief extracts as well as titles of the publications of foreign agricultural experiment stations and kindred institutions, and the importance of appropriations for extending the work of the Department in the line of rural engineering.

The funds of the association have been economically administered, and the report of the treasurer will show a satisfactory balance in the treasury, with no outstanding obligations.

It is with sincere sorrow that your committee makes official record of the death on October 1, 1904, of Maj. Henry E. Alvord, one of the founders of this association, a former president and for many years the able and efficient chairman of its executive committee. The association will no doubt be moved to express in suitable manner its regret for this sad occurrence, and its appreciation of the character and services of its late honored member.

H. C. White, *Chairman.*

On motion of H. P. Armsby, of Pennsylvania, the report was accepted, and the executive committee was instructed to arrange for the discussion of the subject of relations of the stations with the U. S. Department of Agriculture, raised by this report, in connection with the report on cooperation (see p. 62).

On motion of H. C. White, the request of members of the association, previously constituting the section on horticulture and botany under the old arrangement, to be allowed to form a division for horticulture and botany in one of the sections of the association, was referred to the section on experiment station work.

Report of Treasurer.

The report of the treasurer was read, as follows:

Report of treasurer of the association, November 17, 1903, to October 31, 1904.

RECEIPTS.

Amount on hand November 17, 1903	$263.26
Amount received from dues	1,525.00
Amount received from National Association of State Universities for services of the joint agent of the passenger associations at Des Moines	6.00
Total	1,794.26

EXPENDITURES.

Expenses of the executive committee	$1,123.85
Expenses of the secretary and treasurer (postage, printing, telegrams, etc.)	19.49
Services of the joint agent of the passenger associations at Des Moines	17.00
Total	1,160.34
Balance on hand October 31, 1904	633.92

E. B. Voorhees, *Secretary-Treasurer.*

On motion, the report was referred to an auditing committee consisting of J. L. Hills, of Vermont, and E. A. Bryan, of Washington, which subsequently reported, as follows:

> Your committee on auditing the accounts of the treasurer respectfully reports that it has surveyed the books of that office, finds them well kept, finds receipts, expenditures, and balance as stated in his report, and finds proper vouchers supporting all expenditures.
>
> Joseph L. Hills,
> E. A. Bryan,
> *Committee.*

On motion, the report was adopted.

Report of Bibliographer.

The report of the bibliographer, A. C. True, was presented, as follows:

During the past year the Department of Agriculture has continued the publication of the index catalogue of medical and veterinary zoology and has also issued special bibliographies of agricultural text-books, school gardens, insects, etc. The usual annual reports concerning the literature and general progress in chemistry, botany, zoology, plant diseases, veterinary medicine, and other general subjects have appeared. Among the list of bibliographies noted below there are many important ones which deal pretty thoroughly with special fields on which good bibliographies did not hitherto exist. Among these subjects we may mention the following: Molds pathogenic for animals; The function of salt in the animal organism; Sericulture; Effect of gases upon cultivated plants; Economic value of birds; Insect enemies of books; Hemorrhagic septicemia; Plant breeding; Blood immunity and blood relationship as determined by precipitin tests for blood; Parthenogenesis; The constituents of milk; Texas fever; The feeding value of sugar-beet pulp and molasses; India rubber and gutta-percha; Roup of fowls; Avian tuberculosis; and Drinking water.

On account of the unusual interest aroused in the subject of tuberculosis as a result of Koch's theories, a great number of bibliographies relating to the different phases of this disease have been prepared and published in connection with articles containing the results of the investigations. All of the bibliographies which have just been referred to are noted more fully in the list of 68 titles which follows:

Andreasch, R., and Spiro, K. Jahresbericht über die Fortschritte der Tier-Chemie (Annual report on the progress in animal chemistry). Jahresbericht über die Fortschritte der Tier-Chemie, 32 (1902), pp. 1141. An extended review of the literature of animal chemistry for the year 1902.

Bailey, L. H. Development of the text-book of agriculture in North America. U. S. Department of Agriculture, Office of Experiment Stations Report 1903, pp. 689–712. A chronological bibliography of North American text-books of agriculture is appended to a discussion of this subject.

Banks, N. A revision of the Nearctic Chrysopidæ. Transactions of the American Entomological Society, 29 (1903), No. 2, pp. 137–162. A list of 18 references to the literature of the subject is appended to the article.

Barbacci, O. Summarischer Bericht über die wichtigsten italienischen Arbeiten im Gebiete der allegemeinen Pathologie und pathologischen Anatomie, erschienen im Jahre 1902 (The most important Italian literature on general pathology and pathological anatomy published in 1902). Centralblatt für Allgemeine Pathologie und Pathologische Anatomie, 14 (1903), No. 16–17, pp. 673–709. A classified list is presented of Italian literature published in 1902 relating to technique, methods of investigation, tumors, cell structure, immunity, intoxications, infectious diseases, organic diseases, etc. A brief abstract is given of the more important works.

Barthelat, G. J. Les mucorinées pathogènes et les mucormycoses chez les animaux et chez l'homme (Pathogenic molds and mucormycoses in animals and man). Archives de Parasitologie, 7 (1903), No. 1, pp. 5–116. A bibliography of 72 titles is given in connection with a critical review of the literature of the subject.

Baumgarten, P. von, and Tangl, F. Jahresbericht über die Fortschritte in der Lehre von den pathogenen Mikroorganismen, 1901 (Annual report on progress in the field of pathogenic micro-organisms, 1901). Leipzig: S. Hirzel, 1903, 2. Abt., pp. XII+1114. This report contains extended bibliographies relating to pathogenic bacteria, fungi, and protozoa, together with brief abstracts of the more important articles.

Belli, C. M. Die Ernährung ohne Salz und ihre Wirkungen auf den Organismus, speziell auf die Assimilation der Nahrungsmittel und auf den Stickstoffwechsel des Menschen (Diet without salt and its effect upon the body, especially upon the assimilation of food and the metabolism of nitrogen in man). Zeitschrift für Biologie, 45 (1903), No. 2, pp. 182–222. A list of 29 references to the literature of the subject is appended to the article.

Bisson, E. Elenco di pubblicazioni attinenti alla bachicoltura, che vennero fuori nel corso del 1902 e 1903 (List of publications relating to sericulture issued during the years 1902 and 1903). Annuario della R. Stazione Bacologica di Padova, 31 (1903), pp. 119–139. A list is given of books and periodical articles on the various lines related to sericulture as published in different languages during 1902 and 1903.

Bongert, J. Beiträge zur Biologie des Milzbrandbacillus und sein Nachweis im Kadaver der grossen Haustiere (Biology of the anthrax bacillus and its demonstration in the carcasses of the larger domesticated animals). Centralblatt für Bakteriologie, Parasitenkunde, und Infektionskrankheiten, 1. Abt., 35 (1903), No. 2, Orig., pp. 198–201. A list of 77 references to the literature of this subject is given.

Brizi, U. Sulle alterazioni prodotte alle piante coltivate dalle principali emanazioni gasose degli stabilimenti industriali (The effect of gases and fumes upon cultivated plants). Le Stazioni Sperimentali Agrarie Italiane, 36 (1903), No. 4–5, pp. 279–384. A bibliography of 101 titles is appended to the paper.

Chapman, F. M. The economic value of birds to the State. Albany: New York State Forest, Fish, and Game Commission, 1903, pp. 66. A brief bibliography of articles relating to the food of American birds is appended.

Correns, C. Neue Untersuchungen auf dem Gebiet der Bastardirungslehre (Recent investigations in plant hybridization). Botanische Zeitung, 61 (1903), No. 8, pp. 114–126. A list of 22 references to the literature of the subject is appended to the article.

Coulter, J. M., and Chamberlain, C. J. Morphology of angiosperms. New York: D. Appleton & Co., 1903, pp. X+348. The bibliographies, which are an important feature of the work, are arranged chronologically at the end of each chapter, and all the citations are brought together at the close of the volume, the arrangement being alphabetical by authors.

Crosby, D. J. A few good books and bulletins on nature study, school gardening, and elementary agriculture for common schools. U. S. Department of Agriculture, Office of Experiment Stations Circular 52, pp. 4.

Dandeno, J. B. The effects of water and aqueous solutions on foliage leaves. Transactions of the Canadian Institute, 7 (1902), II, No. 14, pp. 237–350. A bibliography of this subject is appended to the article and appears on pages 346–350. It includes 107 titles.

Dyé, L. Sur les culicides (Observations on the Culicidæ). Archives de Parasitologie, 6 (1902), No. 3, pp. 359–376. The literature of the subject is reviewed in connection with a brief bibliography.

Enriquez, E., and Sicard, J. A. Les oxydations de l'organisme (Oxidations in the animal organism). Paris: J. B. Baillière & Sons, 1902, pp. 87. A bibliography of the subject is appended.

Fruwirth, C. Referate über neuere Arbeiten auf dem Gebiete der Pflanzenzüchtung (References to recent work in plant breeding). Journal für Landwirthschaft, 51 (1903), Nos. 2, pp. 223–230; 4, pp. 371–387. References are given to 48 recent articles on plant breeding, with a brief abstract of the article in each case.

Greiner, T. The new onion culture. New York: Orange Judd Co., 1903, rev. and enl. ed., pp. 112. A list of station and Department publications on onion culture is appended.

Guillerey, J. Ueber den epizootischen Abortus der Stuten (Epizootic abortion in mares). Archiv für Wissenschaftliche und Praktische Thierheilkunde, 29 (1903), No. 1–2, pp. 37–68. The literature of this subject is critically discussed in connection with a bibliography of 32 titles.

Hemenway, H. D. List of articles published on school gardens. Transactions of the Massachusetts Horticultural Society, 1902, II, pp. 249–254. The list includes 65 articles.

Herrera, A. L. Bibliografía relativa á los insectos que destruyen las cortezas (A bibliography relating to insects injurious to bark). Boletín de la Comisión de Parasitología Agrícola, 2 (1903), No. 3, pp. 104–114. A list of articles largely compiled from publications of this Department.

Hilger, A., and Dietrich, T., et al. Jahresbericht über die Fortschritte auf dem Gesamtgebiete der Agrikultur-Chemie, 1902 (Annual report of the progress in agricultural chemistry, 1902). Berlin: Paul Parey, 1903, pp. XXXVI + 580.

Hoffmann, A. Untersuchungen über den Einfluss der Hetolbehandlung auf die Impftuberculose der Meerschweinchen und der Kaninchen (The effect of treatment with hetol upon inoculation tuberculosis of guinea pigs and rabbits). Archiv für Wissenschaftliche und Praktische Thierheilkunde, 30 (1904), No. 1–2, pp. 162–187. A list of 37 references to the literature of the subject is appended to the article.

Houlbert, C. Les insectes ennemis des livres (Insect enemies of books). Paris: Alphonse Picard & Sons, 1903, pp. XXXVIII + 269. A list of 94 references to the literature of this subject is given.

Istvánffi, G. de. Études sur le rot livide de la vigne (Studies on the white rot of grapes). Annales de l'Institut Central Ampélologique Royal Hongrois, 2 (1902), pp. 288. Numerous footnote references are given, which constitute a very extensive bibliography of the literature of the subjects treated.

Kellerman, W. A. Index to North American mycology. Journal of Mycology, 10 (1904), Nos. 71, pp. 116–143; 72, pp. 182–194; 73, pp. 251–283. An alphabetical list of articles, authors, subjects, new species and hosts, new names and synonyms is given in each number of this journal.

Kirsten. Die Varietäten des *Bacillus œdematis maligni* (The varieties of *Bacillus œdematis maligni*). Archiv für Wissenschaftliche und Praktische Thierheilkunde, 30 (1904), No. 3, pp. 223–260. A critical review of the literature of this subject with an extensive bibliography.

Kleptzov, K. 'Z. K voprosu o passivnom immunitetye pri gemorragicheskikh septitzemiyakh (Passive immunity in various forms of hemorrhagic septicemia). Archiv Veterinarnuikh Nauk, St. Petersburg, 33 (1903), Nos. 6, pp. 553–581; 7, pp. 685–700; 8, pp. 781–815. The literature relating to swine plague, hemorrhagic septicemia in cattle, and other related diseases is critically discussed, in connection with a bibliography including 67 titles.

Klöckér, A. Translated by G. E. Allan and J. H. Millar. Fermentation organisms. New York: Longmans, Green & Co., 1903, pp. XX + 392. A bibliography of the more important works relating to this subject is given on pages 347–381.

Kossel, H., et al. Vergleichende Untersuchungen über Tuberkelbazillen verschiedener Herkunft (Comparative investigations on tubercle bacilli of different origin). Tuberkulose-Arbeiten aus dem Kaiserlichen Gesundheitsamte, 1904, No. 1, pp. 1–82. This article contains a bibliography of 194 titles.

Krompecher, E., and Zimmermann, K. Untersuchungen über die Virulenz der aus verschiedenen tuberkulösen Herden des Menschen reingezüchteten Tuberkelbacillen (The virulence of tubercle bacilli in pure cultures from tuberculous foci in man). Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten, 1. Abt., 33 (1903), No. 8, Orig., pp. 580–607. A list of 18 references to the literature of the subject is appended to the article.

LAVINOVICH, M. Popuitka lyecheniya sapa i immunizatzii protiv nego y koshek i morskikh svinov (Experiments in the treatment of glanders and immunization of cats and guinea pigs against this disease). Archiv Veterinarnuikh Nauk, St. Petersburg, 33 (1903), No. 3, pp. 211–226. A list of 34 references to the literature of the subject is given.

MACDOUGAL, D. T. The influence of light and darkness upon growth and development. Memoirs of the New York Botanical Garden, 2 (1903), pp. XIII+319. The footnotes include over 200 references to the literature of the subject.

MARCHAL, E. Revue des travaux de pathologie végétale, 1902 (Review of work on vegetable pathology, 1902). Bulletin Cercle d'Études des Agronomes de l'État [Brussels], 1903, No. 8, pp. 379–389. A review of the literature of this subject, to which a list of 49 references is appended.

MERRILL, E. D. Botanical work in the Philippines. Philippine Bureau of Agriculture Bulletin 4, pp. 53. A list of the more important books relating to this subject is appended.

MICHAEL, A. D. British Tyroglyphidæ. London: Ray Society, 1903, vol. 2, pp. VII+183. A list of the prinicipal books and papers giving information relative to the Tyroglyphidæ.

MONFALLET, D. Bibliographie abrégée des infections (Abridged bibliography of infectious diseases). Paris and Santiago: C. Goffi, 1903, pp. 65. In this bibliography the author's purpose was to present for the practical investigator and student a list of the most important publications relating to the various infectious diseases of animals and man. The number of diseases on which bibliographies are presented is about 90.

NASMITH, G. G. The chemistry of wheat gluten. Transactions of the Canadian Institute, 7 (1903); University of Toronto Studies, Physiological Series, 1903, No. 4, pp. 22. A list of 35 references to the literature of the subject is appended.

NUTTALL, G. H. F. Blood immunity and blood relationship, a demonstration of certain blood relationships amongst animals by means of precipitin tests for blood. Cambridge: University Press, 1904, pp. XII+444. The literature relating to serum constituents and immunity is critically discussed in connection with an extensive bibliography.

OTTAVI, E., and MARESCALCHI, A. Bibliographia agronomica universalis. Casale: Ottavi Bros., 1903, Nos. 2, pp. 57–128; 3, pp. 129–176; 4, pp. 177–263. This is a continuation of the general agricultural bibliography noted in the previous report. The number of articles noted has reached 2,094. Articles in Italian, French, German, and English are included.

PANOV, N. O bugorchatkye vuizuivaemoi u zhivotnuikh mertvuimi tuberkulezuimi batzillami (Tuberculosis caused by dead tubercle bacilli). Dissertation, Yuriev, 1902, pp. 134. The literature of this subject is critically reviewed in connection with a bibliography of 101 titles.

PEIRCE, G. J. A text-book of plant physiology. New York: Henry Holt & Co., 1903, pp. VI+291. References to literature given in footnotes serve as a considerable bibliography of the subjects treated.

PHILLIPS, E. F. A review of parthenogenesis. Proceedings of the American Philosophical Society, 42 (1903), No. 174, pp. 275–345. A critical review is given of the literature of this subject in connection with an extensive list of references.

PHILLIPS, W. F. R. Recent papers bearing on meteorology. U. S. Department of Agriculture, Weather Bureau, Monthly Weather Review, 31 (1903), pp. 334, 373, 413, 473, 521, 569.

PREISZ, H. Studien über Morphologie und Biologie des Milzbrandbacillus (The morphology and biology of anthrax bacillus). Centralblatt für Bakteriologie, Parasitenkunde, und Infektionskrankheiten, 1. Abt., 35 (1904), No. 6, Orig., pp. 660–661. A list of 23 references to the literature of this subject.

PRESCOTT, S. C., and WINSLOW, C. E. A. Elements of water bacteriology. New York: John Wiley & Sons; London: Chapman & Hall, Ltd., 1904, pp. X+162. A list of 180 references to the literature of the subject is given.

RABINOWITSCH, LYDIA, and KEMPNER, W. Die Trypanosomen in der Menschen- und Tierpathologie, sowie vergleichende Trypanosomenuntersuchungen (Trypanosomata in human and animal pathology). Centralblatt für Bakteriologie, Parasitenkunde, und Infektionskrankheiten, 1. Abt., 34 (1903), No. 8, Originale, pp. 804–822. The literature relating to trypanosomata is critically reviewed in connection with a bibliography of literature published during the years 1898–1903. The references given number 150.

Raudnitz, R. W. Bestandteile, Eigenschaften und Veränderungen der Milch (The constituents of milk—their properties and changes). Ergebnisse der Physiologie, 2 (1903), pp. 193–325. This is a general review of the literature of this subject, the bibliography including about 670 references.

Regn, H. Der Bakteriengehalt des von Rauschbrand befallenen Muskelgewebes und der Rauschbrandimpfstoffe (The bacterial content of muscle tissue affected with blackleg and of blackleg vaccine). Archiv für Wissenschaftliche und Praktische Tierheilkunde, 30 (1904), No. 3, pp. 261–280. A brief bibliography of the subject is appended to the article.

Schmidt, A. Die Zeckenkrankheit der Rinder—Hæmoglobinæmia ixodioplasmatica boum—in Deutsch-, English-Ostafrika und Uganda (The tick disease of cattle (hæmoglobinæmia ixodioplasmatica boum) in German and English East Africa and Uganda). Archiv für Wissenschaftliche und Praktische Thierheilkunde, 30 (1904), No. 1–2, pp. 42–101. The literature of this subject is discussed with reference to a bibliography of 221 titles.

Schmoeger, M. Presslinge, Diffusionsschnitzel, Melasse (Beet diffusion residue and molasses). Die Landwirtschaftlichen Versuchs-Stationen, 59 (1903), No. 1-2, pp. 83–155. Numerous references to the literature of the subject are given in footnotes.

Seeligmann, T., Torrilhon, G. L., and Falconnet, H. Translated by J. G. McIntosh. India rubber and gutta-percha. London: Scott, Greenwood & Co., 1903, pp. XI+402. A bibliography of 404 references to the literature of the subject is given on pages 385–396.

Sergent, E. La lutte contre les moustiques (The warfare against mosquitos). Paris: J. Rueff, 1903, pp. 96. The literature relating to methods for exterminating mosquitoes is discussed, and a list of 110 references given.

Stiles, C. W., and Hassall, A. Index-catalogue of medical and veterinary zoology. U. S. Department of Agriculture, Bureau of Animal Industry Bulletin 39, part 6, pp. 437–510. This part of the bulletin includes authors whose names begin with the letter F.

Streit, H. Untersuchungen über die Geflügeldiphtherie (Fowl diphtheria). Zeitschrift für Hygiene und Infectionskrankheiten, 46 (1904), No. 3, pp. 407–462. A list of 46 references to the literature of the subject is appended to the article.

Stutzer, A. Die Behandlung und Anwendung des Stalldüngers (The management and use of barnyard manure). Berlin: Paul Parey, 1903, 2. ed. enl., pp. VIII+168. A list of 102 references to the literature of the subject is given.

Swithinbank, H., and Newman, G. Bacteriology of milk. London: John Murray, 1903, pp. XX+605. Numerous references to the literature of this subject are given in footnotes.

Tennert. Ueber *Trichorrhexis nodosa* mit spezieller Berücksichtigung der Aetiologie und Therapie (*Trichorrhexis nodosa*, with special regard to its etiology and treatment). Zeitschrift für Veterinärkunde, 14 (1902), No. 8–9, pp. 361–372. A brief bibliography is appended to the article.

Thiele, R. General-Register der Hygienischen Rundschau, Band I–X, 1891–1900 (Index to Hygienische Rundschau, volumes 1–10, 1891–1900). Berlin: August Hirschwald, 1904, pp. 432.

Trink- und Gebrauchswasser (Water used for drinking and similar purposes). Zeitschrift für Untersuchung der Nahrungs und Genussmittel, 6 (1903), No. 22, pp. 1040–1059. Brief abstracts of and references to 60 recent articles relating to this subject.

Vandevelde, A. J. J. Répertoire des travaux publies sur la composition, l'analyse et les falsifications des dendrées alimentaires pendant l'année 1902 (Review of the literature of composition, analysis, and adulteration of foods for the year 1902). Separate from Bulletin du Service de surveillance de la Fabrication et du Commerce des Dendrées Alimentaires, 1903, pp. 95. This contains 691 references and is the third volume on this subject.

Viala, P., and Ravaz, L. American vines; their adaptation, culture, grafting, and propagation. San Francisco: California Wine Assoc., 1903, pp. 299. A bibliography of the writings of 72 authors is contained in the appendix.

Vincent, J. Notes bibliographiques sur les nuages—classification et nomenclature (Bibliographic notes on clouds—classification and nomenclature). Annuaire météorologique pour 1903. Brussels: Observatoire Royal de Belgique, 1903, pp. 430–449.

Waterhouse, F. H. Catalogue of the library of the Zoological Society of London. London: Taylor and Francis, 1902, 5. ed., pp. 856. Titles are given of about 11,000 works in the library of the Zoological Society, together with a list of periodicals received.

Weber, A., and Bofinger, H. Die Hühnertuberkulose (Avian tuberculosis). Tuberkulose-Arbeiten aus dem Kaiserlichen Gesundheitsamte, 1904, No. 1, pp. 83–158. A bibliography of 183 titles is appended to this article.

Weigmann, Hött, and Gruber. Fortschritte auf dem Gebiete der Chemie, Hygiene, und Bakteriologie der Milch und ihrer Erzeugnisse (Progress in the field of the chemistry, hygiene, and bacteriology of milk and its products). Chemiker Zeitung, 28 (1904), No. 19, pp. 229–232. A summary of the literature during 1903, 128 references being given in footnotes.

Zeiil, A. Die Carpalbeule des Rindes und ihre Behandlung (Bursal enlargements upon the carpus of cattle and their treatment). Archiv für Wissenschaftliche und Praktische Thierheilkunde, 29 (1903), No. 5, pp. 445–475. A critical discussion of the literature of this subject, with a bibliography of 81 titles.

The report was accepted.

Collective College and Station Exhibit at St. Louis.

W. H. Jordan, chairman, submitted the following report of the committee in charge of the collective exhibit of the Association of American Agricultural Colleges and Experiment Stations at the Louisiana Purchase Exposition:

Your committee deems it expedient at this time to make only a comparatively brief report of the results of its labors. It is impossible to present now a complete and final report of the exhibit under our charge. As the exhibit is certainly worthy of an extended report commensurate with the extent and dignity of the display which has been made of the work of the institutions represented, we feel that its preparation must be delayed until the final completion of all matters coming under our jurisdiction. Our purpose, therefore, at this time, is simply to lay before you a few general facts summarizing the results of the effort which you placed in our hands.

In the first place, the committee desires to express its gratification at the outcome of the decision to locate the main portion of this exhibit as a unit in the Palace of Education. Considerable pressure was brought to bear upon us in favor of locating the agricultural part of the exhibit in the Agricultural Building, but your committee was unanimously of the opinion that there is no good reason why agricultural education should maintain its class relations any more than instruction in the principles of steam or electrical engineering. Previous exposition displays of the work of the agricultural departments of the colleges and of the agricultural experiment stations have been located in the Agricultural Building, and so, for the first time, the work of these institutions has taken its rightful place among the great educational efforts of our nation, and in this way has secured a recognition that otherwise would not have been possible.

There is one feature of this exhibit which we believe to be worthy of comment. It was not a "show" exhibit. Mere beauty or novelty of display was not the main object sought. While every reasonable effort was put forth to make it attractive in its design, arrangement, and coloring, the materials which were selected for display were those which are in actual use for the purposes of instruction in the various departments of our land-grant colleges, or those which represent with as much realism as possible the actual practical results of research. We are glad to have been assured that the exhibit was found profitable for study on the part of the real seekers after information, and that it impressed itself upon intelligent observers as a worthy and consistent exposition of certain features of education and research in the relations of science to agriculture and the mechanic arts.

INSTALLATION AND MAINTENANCE OF EXHIBIT.

The exhibit in the Palace of Education has been installed practically in accordance with the plan presented to the association in the report of your committee at the meeting of this association in 1903. Fifty-one institutions are represented. In the preparation of the various sections 24 experts generously assisted, who discharged their duties in a manner highly satisfactory to the committee. The explanation of the Palace of Education exhibit to the visiting public has been accomplished by the use of expert demonstrators, generally students or graduates of some land-grant college, 8 being on duty at one time.

The number of persons appointed to positions of one kind or another in connection with the exhibit as a whole and paid from the appropriation, either for services or traveling expenses, has been 230, divided as follows:

Members of the committee	9
Experts in charge of sections	24
Expert demonstrators, inside exhibit	26
Experts connected with outside exhibit	17
Lecturers connected with outside exhibit	31
Students used in outside exhibit demonstration	50
Officers of administration, clerks, stenographers, janitors, guards, etc	73
Total	230

This seems to be a large force, but is really the smallest number with which it has been feasible to install and maintain the exhibit as a real and live demonstration of our work. Your committee has used every reasonable effort to hold the expenses for such services to the lowest possible practicable point. It should be noted that when any expenditure was involved, no matter how brief the service, even if but for a day, an appointment by the Government board has been necessary, so that the number of appointments is more formidable than the actual expense connected therewith.

EXPENDITURES.

The financial situation is gratifying. Up to October 24 the expenditures were approximately the following:

Preparation and collection of exhibit	$19, 527. 48
Installation	27, 439. 05
Maintenance	8, 650. 75
Administration	15, 388. 01
Total	71, 005. 29

It is clear that the expenditures for the exhibit will come well within the appropriation. In fact, it now seems likely that there will be an unexpended balance, a result neither anticipated nor desired by your committee. This is to some extent due to the fact that the expenditures for the outside exhibit in plant breeding and animal husbandry were less than was planned. Difficulties which need not be mentioned in this connection, and for which your committee does not hold itself responsible, were encountered in arranging for the outside exhibit, and it was only by the most strenuous efforts that this portion of our display was finally accomplished, and as a general result the demonstration work of this division was necessarily abridged, the first period of two weeks, or one-third the whole time planned, being necessarily omitted entirely.

THE OUTSIDE EXHIBIT.

The outside exhibit, as stated, was accomplished only after overcoming serious difficulties; nevertheless it should be regarded as a useful and important feature. It covered demonstration work in plant breeding, corn judging, stock judging, and slaughter tests displaying the results of experiments in the feeding of animals. These demonstrations occupied two periods, the first extending from September 11 to September 24, inclusive, and the second from October 3 to October 16, inclusive. Approximately 50 lectures were given during these periods by specialists on topics directly related to the subjects above mentioned, and in displaying methods of instruction 50 students collected from various institutions were in attendance on the exhibit from time to time.

RECOGNITION OF EXHIBIT.

It is not too much to claim that this exhibit in all its divisions has been fairly successful. This is evident both from the remarks which have been made concerning it by competent judges as well as from the awards granted by the several juries. These awards, exclusive of those granted to collaborators, are as follows:

Grand prizes	24
Gold medals	41
Silver medals	35
Bronze medals	35
Total	135

EXPLOITATION OF THE WORK OF THE COLLEGES AND STATIONS.

At the last meeting of your committee, held on June 27, 1904, a somewhat unusual plan was adopted, but it is hoped an efficient and useful one, for exploiting the work of the institutions represented in this exhibit. At that time arrangements were perfected with a magazine writer of recognized ability to present various phases of our work in some of the leading magazines of this and other countries, the exhibit itself being made the occasion of these articles and the center around which they are to be grouped. While none of these articles have as yet appeared, they are in the process of preparation; and arrangements are definitely made with leading magazines for the publishing of a portion of them. It is hoped that in this way we may be able to reach that part of the intelligent public, which now knows very little about our work, with dignified and interesting discussions of what we are now doing and of the bearing of our educational and research efforts upon the social and economic interests of this country.

THE DISPOSAL OF THE EXHIBIT.

The next important question to be considered is what shall be the fate of this exhibit which has cost so much effort and money. There seems to be a desire on the part of some that it shall somehow be preserved in a permanent form to be enlarged and improved as time and occasion permit. It is also suggested that it be preserved for utilization at other expositions in this and foreign countries. The various articles may also be returned, with the consent of the Government board, to the institutions furnishing or preparing them. The final disposal of the exhibit is a matter which your committee will have to consider at no very distant date, concerning which we desire your advice and, if necessary, your instructions.

ACKNOWLEDGMENTS.

Your committee deems it a pleasure to record in this connection its hearty appreciation of the pleasant relations which have existed between it and the Government board from the beginning of our official connection. Throughout all this time this board has given to your committee the most prompt and efficient support. The thanks of the association are due to the honorable Secretary of Agriculture and to the Office of Experiment Stations under his charge for indispensable aid in organizing the exhibit in many of its details. We are also under deep obligations to the officials of the Exposition, especially to Mr. H. J. Rogers, chief of the Palace of Education, for the facilities which have been placed at our disposal and for the uniform courtesy with which we have been treated. The loyal support of the institutions represented in this association has been a main factor in the success of our exhibit, and we desire to especially recognize the aid of those institutions which have so generously donated the time and services of men and which have contributed to the preparation of materials for display. Without such support from certain colleges and stations your committee would have been unable to perform the duties devolving upon it. Your committee deems it a pleasure to recognize in this public way the able services of Mr. James L. Farmer, chief special agent of the Government board, who has managed the business affairs of the exhibit with singular tact and efficiency.

W. H. Jordan,
For the Committee.

On motion the report was accepted, and the committee was authorized to take steps, under regulations established by the Government board, to close up and dispose of the exhibit.

COMMUNICATION FROM NATIONAL ASSOCIATION OF STATE UNIVERSITIES.

The chairman of the executive committee read the following communication from the National Association of State Universites:

The National Association of State Universities in annual meeting assembled sends fraternal greetings to the Association of American Agricultural Colleges and Experiment Stations, and begs to express its friendly sentiment and its cordial good wishes for a pleasant and profitable session, and to venture the hope that these two associations through their annual meetings may be greatly instrumental in promoting the cause of the highest and the higher liberal professional and technical education in the United States.

G. E. MACLEAN, *President*.
GEORGE E. FELLOWS, *Secretary*.

UNIFORM FERTILIZER AND FEEDING STUFF LEGISLATION.

H. J. Wheeler, chairman, presented the following report of the committee on this subject:

In the course of the past year your committee, as heretofore, has been in correspondence with parties in several States who were interested in the passage of new fertilizer laws or in the amendment of existing ones.

Arizona, Idaho, New Mexico, Nevada, Montana, Wyoming, and Utah have not yet felt the necessity of legislation in this line. In Colorado and Arkansas recent attempts to pass such laws have been defeated. The following reports have been received from some of the other States:

Ex-Director Huston, of Indiana, reports that the existence of the recommendations of this association was of much assistance in connection with steps taken to amend the old fertilizer law in that State. The law as enacted was made to correspond to the recommendations in certain particulars, and the other points were practically all left to the discretion of the executive officer, thus rendering it possible to make rules in accordance with the recommendations.

Professor Ladd, of North Dakota, reports that at the last session of the legislature in that State a fertilizer law was enacted and that the bill was drawn in accordance with the recommendations of this association, which, he says, were very helpful in the preparation of the bill "and in securing the necessary legislative action thereon."

R. E. Rose, State chemist, Tallahassee, Fla., writes that the law in that State has recently been amended to conform, in so far as possible, with the recommendations concerning uniformity. He adds that the recommendations were of material service.

Prof. F. B. Mumford, of Missouri, reports that the law in that State has been amended recently and that the recommendations were of "much assistance."

President McBryde, of Virginia, reported, July 4, 1903, that changes in the law in that State were then being considered and that amendments in the line of the recommendations were being urged. In conclusion he says: "It follows, therefore, that your recommendations will be helpful in securing the legislation needed."

Director Armsby reports that the recently amended law of Pennsylvania conforms very largely in substance to the recommendations.

Director Soule, of Tennessee, states that a new law was passed in that State in April, 1903. The law was drawn with the object of making it conform with the recommendations of the associations, but a few amendments were made not in harmony therewith which it is believed weakened the law. He adds that it is hoped later to secure such amendments as will make the law conform to the original draft, and that "had it not been for the existence of the recommendations it would probably not have been possible to secure the passage of the present law."

Director J. F. Duggar, of Alabama, writes, under date of July 7, that in that State "the old law has been replaced this year by a new one which embodies the recommendations of the Association of American Agricultural Colleges and Experiment Stations and of the Association of Official Agricultural Chemists," and that "the recommendations alluded to have had much weight in securing the revision of legislation along this line."

After careful consideration of the subject your committee submits the following recommendations regarding laws regulating the sale of feeding stuffs:

(1) That for the purpose of defraying the expenses of feeding-stuff inspection the State should preferably make a direct appropriation.

(2) That the following materials should be exempt from the provisions of feeding-stuff laws: Hays and straws and whole unmixed seeds, such as wheat, rye, barley, oats, Indian corn, buckwheat, broom corn, peas, and the unmixed meals of the entire grains of such seeds.

(3) The term "concentrated feeding stuff" should include linseed meals, cotton-seed meals, cotton-seed feeds, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewers' grains, dried distillers' grains, malt sprouts, hominy feeds, cerealine feeds, germ feeds, rice meals, oat feeds, corn and oat chops, corn and oat feeds, corn bran, ground beef or fish scraps, condimental foods, poultry foods, stock foods, patented proprietary or trade-marked stock and poultry foods, and all other materials of a similar nature not included in section 2 above. Where practicable the by-products from the milling of wheat, rye, and buckwheat should be included under the requirements of the laws.

(4) That a legible printed statement should be affixed to or printed on each package containing a feeding stuff named in section 3, giving the net weight of the package, the name and address of the manufacturer or importer, the name, brand, or trade-mark under which the article is sold, and the guaranteed analysis showing the percentage of crude protein and of crude fat and a maximum of fiber which shall not be exceeded.

The law should provide that the chemical analysis, including determinations of crude fiber, crude protein, and crude fat, shall be made by the official methods of the Association of Official Agricultural Chemists.

If the feeding stuff is sold in bulk or put up in packages belonging to the purchaser, the agent or dealer shall furnish him with a certified statement of the net weight of the lot, the name and address of the manufacturer or importer, the brand or trade-mark under which said article was sold, and the percentage of crude protein and crude fat which said article is guaranteed to contain as determined by the official methods of the Association of Official Agricultural Chemists.

(5) That a certified copy of the statement in section 4, above, be filed with the executive officer each year.

(6) That the law should contain a penalty, by fines only, for violations of its provisions.

The committee recommends to the Association of American Agricultural Colleges and Experiment Stations the adoption of the recommendations 1 to 6, inclusive, with the suggestion that this or some other committee should be instructed to use its efforts to secure the end in view by using its influence to aid in securing uniform legislation in the several States.

H. J. Wheeler,
Chas. D. Woods,
E. H. Jenkins,
H. P. Armsby,
M. A. Scovell,
Committee.

H. J. Wheeler, of Rhode Island. At the meeting last year your committee made certain recommendations in regard to feeding-stuff laws in the United States. This recommendation went to the section on agriculture and chemistry, and was referred to the general session, and owing to objections which were made to one clause it was referred again to your committee. The committee begs leave to report the recommendations made last year with the modification of section 1. Section 1 read last year: "That for the purpose of defraying the expenses of feeding-stuff inspection the State should make a direct appropriation, or where this is impracticable a brand tax should be levied. In view of the experience of Maine and Vermont a tonnage tax is not to be recommended."

Your committee now recommends that this read as follows: "That for the purpose of defraying the expenses of feeding-stuff inspection the State should preferably make a direct appropriation." In other respects the recommendations stand exactly as they did last year.

One other matter was referred to your committee, a communication received from Doctor Hopkins, of Illinois, which I believe was presented to the section on agriculture and chemistry: "Shall we say ammonia or nitrogen, phosphoric acid or phosphorus, potash or potassium?"

Your committee held a meeting in March, 1904, in New York, at which various matters were under consideration, and at that time it was deemed by the committee inadvisable, in view of the fact that a large number of the States had passed laws using the terms phosphoric acid and potash, to go back and undo all that work and change to potassium and phosphorus.

C. G. HOPKINS, of Illinois. This matter of the terms to be used in connection with fertilizers, as well as in stating analyses of other matters, as soils and ash, is now also being considered by the Association of Official Agricultural Chemists, having been taken up by that association at the St. Louis meeting. A committee has been appointed by that association to consider the entire question of nomenclature of such materials as require chemical analysis and statement of the constituents found, and I should be sorry to see final action taken by this association at this time. It seems to me it would be well to appoint a committee to act jointly with the committee from that association to bring in a joint report at our next annual meeting, rather than to take any final action at this time. I think our first duty as an association is to the American farmer. The thing which will ultimately be of the greatest benefit to the American agriculturist is the thing we should do. I realize we have considerable literature pertaining to soils and fertilizers in America, and that we have quite a diversified system of naming the three principal constituents of fertilizers. In the literature in perhaps one-third of the States they say ammonia, and in two-thirds of the States they now say nitrogen, under State laws. In nearly all the State literature we see phosphoric acid when phosphorus pentoxid is meant, although in any of the other sciences—such as pharmacy and medicine—when they say phosphoric acid they mean that. The literature which comes from the U. S. Department of Agriculture says potassium, and not potash, and it says PO_4 instead of P_2O_5, so there is by no means perfect harmony in the conditions we now have. It has seemed to me the longer I have studied the question of soils and fertilizers the more necessary it is that we simplify this unnecessarily complicated situation. I suppose many of you have tried to explain to the practical common-sense farmer why it is we pay for potash (K_2O) when we buy potassium as chlorid (KCl). That is, we value potassium chlorid on the basis of potassium oxid, although there is no potassium oxid in potassium chlorid. In my own experience I have found that the situation becomes ridiculous to the common-sense farmer, and scientists are responsible for it. We persist because it would require a little extra clerical work to go over our records and make some changes. Surely we must do the thing which is simplest for the practical man. American agriculture is going to advance as the farmer understands the business.

H. J. WHEELER. I wish to say that the committee is in most hearty accord with Doctor Hopkins in his idea of simplifying matters. But this association and the association of chemists made certain recommendatons a number of years ago and both have been working hand in hand to secure the adoption of laws in the various States in accordance with a certain line of uniformity, and many of the States of the Union have already, after long effort, been persuaded to change their laws in accordance with those recommendations. To make any change to-day would mean to undo all we have done in the last eight or ten years. It is quite another proposition to take up the matter of nomenclature in regard to ordinary station work. I therefore move that the matter of the nomenclature used in the reporting of experiment station work be referred to the section on experiment station work for their consideration.

The motion was carried. (See p. 117.)

METHODS OF SEED TESTING.

E. H. Jenkins, chairman of the standing committee on seed testing, submitted the following report:

Since the last meeting of the association the committee has submitted its revision of the rules for seed testing to a number of those interested in the work for further suggestions, and the final revision of the work has been printed and distributed by the Office of Experiment Stations as Circular No. 34, revised, pp. 24, with the title—Rules and Apparatus for Seed Testing. It is the hope of the committee that the methods prescribed will commend themselves to those who are engaged in seed testing and be adopted by them.

The committee will gratefully receive any criticism of the methods or suggestions for their improvement.

All of which is respectfully submitted.

E. H. JENKINS, *Chairman.*
F. W. CARD.
W. R. LAZENBY.
E. BROWN.
A. D. SHAMEL.

The report was accepted.

MILITARY INSTRUCTION.

The following report was received from the chairman of the committee on this subject through the chairman of the executive committee:

Several matters of special interest to all the institutions were referred to this committee by the convention at its last annual meeting, but as they appear upon the printed programme it is unnecessary to repeat them here. They involve matters of the very highest importance to all the colleges in the association, and I may be permitted at the outset to express my deep regret that I am compelled to make only a brief and incomplete report. During all the early part of the year the condition of my health was such as to keep me under a physician's care for several months; during which time I was able to perform only a small part of my own regular duties, and the only outside matters to which I gave the slightest attention were in connection with meetings of the executive committee of this association. This word of explanation is due to my associates as well as to myself, and I hope the personal allusion may be pardoned. In any case, it is difficult to secure meetings of a committee the members of which are so widely scattered, and especially when those meetings, in order to be productive of permanent results, must be made to coincide with the convenience of officials in one of the great departments of the Government. Such a meeting, in order to avoid waste of time, should have before it some definitely considered body of proposals which had been previously submitted to all the members and which might thus form the basis of definite action to be proposed to the department concerned. Owing to my inability to give sufficient consideration to the important questions involved to justify me in trying to formulate such proposals for the committee no meeting has been called during the year, but I beg to suggest that even this, unfortunate as it seems, may not be altogether without its advantages.

The attention of all the colleges has been necessarily fixed to a greater or less extent upon the working of the system which the War Department is now trying to carry out, and all are probably in a better position to make an estimate of its advantages and disadvantages than they were a year ago. Considerable correspondence has been carried on with different institutions relative to special cases as they arose, and a number of important suggestions have been made by them, some of which may form the basis of future deliberation and action. To President Fellows, of Maine, special thanks are due for the valuable work that he has done in this connection.

The chairman of the committee has had two prolonged interviews with the Chief of Staff of the Army, the first of which resulted in an extension of the detail of military officers to colleges from two years to three, and the second in a better mutual understanding of some of the points at issue between the colleges and the Department. The position of the Department, stated in the briefest form, is this, that, since the Government furnishes officers and equipment for giving military instruction, it has a right to expect both a hearty cooperation and an equivalent return from the colleges; that, since military instruction is the end sought by the law and by those who are charged with the administration of it on behalf of the Government, that instruction should be made efficient, and the colleges should, as far as necessary, organize their schedules of work accordingly; and, still further, that, while these details are of great advantage to the individual officers concerned, and thus to the entire military establishment, yet the primary need of the Army is to have its officers directly at work with their respective commands. The force of this last consideration will appear when it is stated that 20 per cent of the officers of the Army are now absent on detached service, and it can be well understood that this fact is an occasion of very grave concern to the head of the Army. It also serves to explain the reasons for wishing to detail to colleges no officers but those on the retired list, a policy which, however desirable from the point of view of the Army, is utterly impracticable from the point of view of the colleges. There is one other point upon which the officers of the Department feel that the necessities of the situation are not always sufficiently considered by the colleges: that is, colleges in a few instances have insisted that if they could not have some particular officer detailed they would prefer to have none at all; and, while the Department is desirous of considering the wishes of the colleges as far as possible in each case, it feels that a specific insistence of that kind, without regard to conditions which may exist in the service, is not reasonable or justifiable.

In response to a suggestion from the chairman of the committee that a meeting of the committee of the association with the Chief of Staff and other officers of the War Department might result in a better understanding and more harmonious action, General Chaffee expressed his very cordial assent and his willingness to arrange for such a meeting.

Geo. W. Atherton, *Chairman.*

H. C. White. At the last convention the following matters were referred to the committee on military instruction:

Resolved, That the committee on military instruction is directed to try and secure some modification of War Department General Orders, No. 94, relating to military instruction in the land-grant colleges, abolishing the fixed five-hour per week requirement for military instruction, and allowing such colleges larger liberty in arranging their programme of weekly exercises.

Resolved, That the committee is further directed to submit to the association at its next convention a draft of recommendation to be, if approved, urged upon Congress looking to more complete provision for the military instruction required of the land-grant colleges.

The report was received and referred to the section on college work and administration for consideration (see p. 91).

Indexing Agricultural Literature.

In the absence of A. C. True, chairman of the committee on this subject, his report was presented by W. M. Hays, of Minnesota, as follows:

W. M. Hays. I want to premise this written statement prepared by Doctor True by stating that this committee has been in existence twelve years, and two of its main objects have been achieved. One is to secure within the Department of Agriculture a scheme of indexing agricultural literature; the other is to have the Library of Congress do the printing, so that institutions and individuals desiring indexes of different classes of agricultural literature may secure them at a nominal cost.

The formal report of the committee follows:

The past year has been marked by two important events in the progress of the work of indexing the literature of agriculture and agricultural science by the Department of Agriculture: (1) The printing of the first installment of a card index of agricultural periodicals by the Department Library, and (2) the publication of a general index to the first 12 volumes of the Experiment Station Record and Experiment Station Bulletin No. 2, by the Office of Experiment Stations.

The card index of agricultural periodicals comprises author and subject indexes and already about 7,000 cards have been printed. The periodicals thus far indexed are Annales de la Science Agronomique, 1884–1903, Landwirthschaftliche Jahrbücher, 1872–1902, and Die Landwirthschaftlichen Versuchsstationen, 1859–1902.

Any number of copies of each card can be purchased as desired. Arrangements have been made with the Library of Congress for the printing and sale of these cards, but the indexing and proof reading are done in the Library of the Department. Circulars of information concerning this work were widely distributed last March to libraries, institutions, and to individuals interested in agriculture and related sciences. The result is a list of subscribers which warrants beginning the work, and it is hoped that the list will be greatly increased after the cards which are ready for distribution have been examined.

The publication of the card index for Department publications has been continued during the past year, as usual, and now numbers 7,483 cards in each set. Libraries and institutions throughout the country continue to apply for the cards, and frequent letters of appreciation of their usefulness are received.

The general index to the first 12 volumes of the Experiment Station Record and Experiment Station Bulletin No. 2 is a subject index which makes a volume of 671 pages.

"The index contains about 125,000 entries, arranged under nearly 55,000 divisions and subheads. It covers all of the experiment station and Department publications received for abstracting up to the beginning of January, 1901, and nearly all of the foreign literature up to that time. It therefore brings the index of this literature practically down to the close of the year 1900; and, as it dates from the beginning of the experiment stations under the Hatch Act, it covers a period of the greatest activity in the development of agricultural science." The preparation of this index involved a vast amount of painstaking and tedious labor on the part of the editor of the Experiment Station Record and his associates, and its successful completion is a very considerable achievement.

The importance of this great work to students, teachers, and investigators is very great. The demand for it has already exhausted the first edition of 1,000 copies, and a second edition is being printed.

The card index of experiment station literature issued by the Office of Experiment Stations has now reached 25,600.

A list of publications of the Agriculture Department 1862–1902 with analytical index (pages 623) has been published by the Superintendent of Documents, Government Printing Office.

A. C. True.
J. A. Clark.
E. Davenport.
W. M. Hays.

Mr. Hays. It is my private opinion, not a part of the committee's report, that this association ought to take some active steps through its executive committee to push matters both as to preparation of the cards and as to their publication by the Library of Congress.

The report of the committee was accepted.

The convention adjourned to meet at 8 o'clock p. m.

Evening Session, Tuesday, November 1, 1904.

The convention was called to order by J. C. Hardy, of Mississippi, the second vice-president.

President W. O. Thompson was introduced, and delivered the annual presidential address, as follows:

Annual Address of the President of the Association—Some Problems in the Colleges of Agriculture and Mechanic Arts.

I. I propose for our consideration this evening a very plain and I trust a very practical theme, upon which I desire to offer a few remarks suggested by my own experience and observation. No effort will be made to discuss in any theoretical way the many interesting questions that pertain to education, but rather to take a broad and comprehensive view of the field and the institutions we represent, with such suggestions as may be helpful.

(1) I assume that there is no lack of appreciation of the fact that these institutions now represent the great national movement in which both nation and State are cooperating with a clearly defined purpose of providing such a type of education as can be readily justified by its relation to the development of our country. Education is strictly a developmental function in which the State seems inevitably to take a larger and larger part. Here the logic of the situation will become sufficiently manifest to warrant a larger participation on the part of the nation as a matter of national development. If such larger part should be taken by the nation, the manner in which such increased expenditures would be made is a matter not now possible of forecast. The varying and sometimes conflicting interests would probably effect such compromises in legislation as to divert the efforts from what might be regarded as in accordance with the most approved theory. It is not necessary to produce here an array of figures prefaced with a dollar mark in order to assure us of the greatness of our work. The contributions made by the National Government in the original Morrill Act have been more or less efficient, depending largely upon the wisdom of the States. After all has been said that can be said on that matter, it remains true that that original act is the foundation on which the colleges stand. The second Morrill Act is a very clear and definite contribution, in which there is a renewed and enlarged participation on the part of the Government. It is not assumed that the national grants are adequate to the maintenance of such colleges as are needed. The smallest States, or the States with the least amount of undeveloped resources, will find before them problems too large for an adequate solution with the limited means at their hands. Indeed, the States where conditions are most unfavorable form the strongest argument for national aid. Here it is that undeveloped resources are few, and here it is that existing resources need to be most carefully husbanded. If the National Government can be justified for undertaking what may be termed the developmental functions of government—and I take it that the history of the past seventy-five years justifies such undertaking—then it would seem the part of wisdom to protect the whole country, and to see to it that no portion of the country is to be so depleted in resources that the maintenance of a population is impossible. It would seem, therefore, that the National Government might with every propriety interest itself in the development of the least fertile and most unlikely portions of the country for the general reason that the nation's interests are as wide as her territory. This phase of the problem is the more urgent because it is here that States will be slow to take hold of the problem, chiefly because they lack the knowledge needed in order to direct them in the wise application of scientific methods to the problem, and further because such States are not usually sufficiently aroused as to the relation of research to state development. On the other hand, the States having a large amount of undeveloped resources can readily see the advantage of development, and are so moved by the prospect of assured profit that they readily make appropriations for investigation and research as an investment, if not in the interest of science.

(2) We are well aware that there is a great diversity of interest shown among the States. This interest has manifested itself in some cases by large and generous appropriations and in others by rather meager provision. There can be no question about the individual State's right, and I also believe of its duty, to take up the developmental functions of government and give its own territory most careful consideration. It is not that in the support of what we would term "technical education," "industrial education," or perhaps better, "economic education," the State will receive immediate returns upon its investment, for that is not always true, but that in such long-time investment, calculated to perpetuate the resources of the State, and to keep the legacy of our fathers as valuable for our children as it has been for us, the State will find ample justification for its expenditures. Men often debate the constitutionality of certain measures, the wisdom of them or the political effect of them, but when they have once been made and men of a later period see the wisdom of such public enterprise, there is little disposition to criticise the action. The present movement in agricultural education has some immediate returns that are a justification, but the complete justification will be at the hands of our children. It is worth our while to keep clearly in mind that this expenditure must inevitably increase. I do not suggest that it will increase with great rapidity, but that the increase of expenditure for education will go with equal step with the increase of the efficiency of our civilization. Indeed, civilization itself as it progresses makes increasing demands upon

the citizens. Primitive life is very simple and beautiful under primitive conditions, but under the conditions of a highly organized civilization primitive life would be decided evidence of degeneration. Civilization brings not only its opportunities, but its duties as well. Education is therefore a constantly expanding problem. These colleges of agriculture and mechanic arts must recognize that up to date their work is only outlined. They must, then, not only as the preservers of the past, the protectors of the future, but as the designated agencies of the State, stimulate and develop the possibilities of both land and men. These institutions therefore stand in a very important relation to society and must help to solve the problems of practical living for the millions of our industrial classes.

It is not unnatural that in the presence of this large expenditure of money and of the tendency to increase this expenditure of money as time goes on the thoughts of men should turn to a consideration of the results of this national movement in education. I have no desire to enter into a discussion that might be tabulated in figures. For our purpose here this evening it might be well to remind ourselves, however, in the first place, that this national movement has given great importance to work in agriculture in the United States Government. The Department of Agriculture now stands as the nation's testimony to the importance of the problems with which it deals. Apart from the movement for these land-grant colleges, it might be seriously doubted whether there could have been such a development of the nation's work as is now organized in the Department of Agriculture. We recognize the importance of the work undertaken by the Government and also the generosity toward the States as shown in the two Morrill acts. We can not fail to recognize the helpful cooperation of the Department of Agriculture with the colleges and stations. Too much could not easily be said in praise of this work. On the other hand, we are quite as much under obligation to recognize the helpful attitude of the several States in making possible the highest efficiency of this national movement. They have gone at the matter with a steady purpose and a steadily growing enthusiasm. The movement has not been by any means a rural one. Our city populations have come to see the intimate relation between the development of agriculture in this country and the prosperity and safety of much of our commerce. They have seen how it affects the quantity of our food supplies, the health of our people, and the permanence of much of our prosperity. Those of us engaged in the agricultural colleges recognize, therefore, that our work could be so incomplete as to be extremely unsatisfactory but for the logical development at Washington. It is also true that they without us should not be made perfect. Indeed, every enterprise of this association has made manifest that the interest of the nation, of the States, of the colleges, and of the people are all one. The work of investigation, the work of supervision, the work of stimulating and aiding the local enterprises all unite to emphasize to us the fact that the nation has been pretty well aroused. The further development of this work must inevitably emphasize the common interest of the entire country and so lead to an increasing intelligence as to the real unity of the country. In the large and broad field of the nation's interests the Department of Agriculture in its several fields of work may be regarded as the logical outcome of the Morrill Act and also as the nation's appreciation of the importance of the colleges and experiment stations. Without design on the part of anyone there has gradually grown up an institution at Washington which gives expression to the national ideals, just as the local college expresses the ideals of the community in which it is located. I am disposed, therefore, to say that the colleges of agriculture and mechanic arts have fully justified their existence by the national influences that have been set to work as a consequence of their founding. On the other hand, the results in a local way that have been realized from these colleges are by no means to be despised. They have wrought out local problems and stimulated local enterprise. They have trained some valuable citizens and produced some efficient men and women. This in itself would be ample justification, but through the agency of these efficient men and women the resources of the country are not only being perpetuated, but increased, so that both local and national governments are finding their patrimony undiminished. These institutions, while devoted to the cause of education, have pointed out the possibilities of increased revenues and trained men to protect themselves in the strenuous struggle for existence.

The results realized from the establishment and maintenance of these land-grant colleges are not to be looked for entirely in the graduates of such institutions or in the renewed interests that may be aroused in either agriculture or mechanic arts. This system of education, which in a way is different from anything else ever undertaken, guards peculiarly the country's ideals concerning the permanent welfare of the masses of the people. I do not think it could be proved that these colleges came in response to a demand from the multitude, but they came rather in response to a demand on the part of a few farseeing men. These men recognized, what I think all now can readily see, that such institutions would be an efficient agency in cultivating on the part of the masses of the people an appreciation of higher attainments and greater excellence in the useful industries of life. It is impossible to measure the value or the power in such enlightened appreciation. It has been truly said in connection with the significance of an educational system in its relation to the progress of civilization, and concerning the duty toward the government of those receiving it, that we can not appreciate it except by considering it from the collective point of view. That is to say, in another way, that the whole people must encourage and maintain a system of education in order that the individuals may be brought to a greater appreciation of it and thus saved from their own tendency to degeneration. This elevating influence of the land-grant colleges is by no means their least valuable result. It is not to be forgotten that the benefits of an education to the individual are proportionately less than the advantages to the other members of a community. I think we are prone to look upon education from a purely individualistic point of view. We are prone to measure it exclusively for what it can do for the individual, forgetting oftentimes that what it does for the individual is but the beginning of its real service. We have not yet entirely escaped the fallacy that agricultural education is for the farmers only and that the work of the experiment stations is for the rural districts. It is true that the primary benefits will be realized first among the people in the rural districts, but it is equally true and highly important that we recognize the truth that education of any sort is a social process the benefits of which can not be confined to the persons engaged in it. Agricultural education touches vitally every interest of society both urban and rural. The experiment station is the guardian of the avenues as truly as of the fields.

Since, then, we can not find the full fruits of our system of education in the fields or in the individuals, we would do well to study its wider importance and deeper significance. In this connection, permit me to say that the very creditable exhibit of the colleges of agriculture and mechanic arts at St. Louis has, in my judgment, been a demonstration of the unity of all education, and in so far as an exhibit could testify, this one—the first one—has shown that the type of education in these colleges has not only ample justification, but occupies an important and hitherto neglected field.

In the phase of education now under discussion there is a manifest tendency to emphasize the materials of education rather than the results of it. It is so easy for us to fix our minds upon the importance of luxuriant yields in the harvest, the splendid types of live stock, or the margin of net profit that producing these things will realize. No doubt these are important considerations. I would not in any degree minimize their importance. Indeed, if we can not exhibit these as among the results of our education there would be great difficulty in justifying such a movement as a new departure in education. When, however, we have done all these things we have not received the most valuable results. It is when the pursuits of life have been made more efficient, and through the efficiency of these pursuits men are made more efficient, and through the greater efficiency of men society itself is more efficient and stable, that government finds its beneficent purposes realized and its investments justified. I regard it as of the highest importance that these ideals shall become the common property of our people. It is no small problem for these land-grant colleges to recognize this problem and deal with it effectively. Our banner must float in full view of the civilization which we encourage.

II. Turning now from what may be called the problems of ideals, I desire to give some attention to the more practical problems of operation, and here I bring to our attention the conditions in farm life that influence for good or evil the efficiency of agricultural education. These conditions, I dare say, are familiar to the members of this association, but are worthy of a quiet hour at our annual meeting. Many of them are general, in the sense that they are to be found wherever agricultural colleges occupy the attention of men. Some are local, in the sense that they are more noticeable in some communities than in others, or in the sense that they are peculiar to particular communities. I make no effort to distinguish these, but call attention to such as are within the horizon of my own observation. These conditions in themselves present a very serious problem. Indeed, they are a series of problems, some of which seem inevitable and perhaps incapable of satisfactory solution. Among these I mention:

(1) The tendency away from the farm, which is so manifest as to be the cause of great anxiety in many communities. There can be no doubt that our cities have had a large accession of the best material in the rural districts. These persons, with a certain moral superiority and excellence of natural endowment, and with manifest inferiority in education, have forced their way to the front in the cities and have become the living examples of the splendid quality of body and mind and heart produced on the farm. This efficiency is to be accounted for in part on the theory of personal taste. Not every person born on the farm is adapted to farming pursuits. People are disposed to follow their likes and avoid their dislikes. The ambitions of men oftentimes reveal their cherished ideals. This, however, does not completely account for the marked tendency away from the farm. We must recognize the prejudice there is against the drudgery associated with much of rural life. We must also recognize the fact that the American people regard the rural accumulations as inadequate and oftentimes as too slow. We recognize also that the rural population has not cultivated a just appreciation of its own importance and of its own dignity. The proverb has it that "every man wants to live in the next county." This restless discontent and unwillingness to solve the problems of life in spite of our surroundings is an evil that grows by what it feeds upon. Something is to be said also concerning the failure to give young men and young women proper opportunities for personal advancement. The young business man feels that he can win when he has opportunity. The business world recognizes that no loss is sustained by giving such young men opportunity. I do not undertake to discuss the reasons in the case, but I think we shall agree that the facts warrant the statement that many a farmer's boy lacks the opportunity for individual initiative so essential for independent positions. The prospect of dependent subordination being continued too long naturally arouses a young man's ambition for a position where he can do for himself. He desires to be his own man and to conduct his own business. There can be no just criticism upon that kind of ambition. It is essential to the perpetuity of a free people. These several items named above operate to help the young man in his decision toward the business world and away from the productive world. The agricultural college has been unjustly charged with educating young men away from the farm. We may as well recognize, however, that in spite of the agricultural colleges this tendency continues. It is no small part of our work to cultivate such a sentiment as will retard this tendency. We should not fail, however, to recognize that under absolutely perfect conditions a large number of rural people should find their way to the city. We can not make lawyers out of all sons of lawyers. Just now the ministry is decreasing in numbers, but we can not look to the manse as the only base of supply. Farmers should not expect all their children to follow the plow or be queens in the kingdom of domestic economy. Such an ideal, if realized, would encourage the class system and open the way for a large amount of inefficiency while closing the door to many and making impossible some of our greatest achievements. There should be a free movement toward the city and an equally free movement toward the farm. In other words, farm life must not be the last resort; it must not be the refuge of necessity; it should be the life of choice, and I may say of enthusiastic choice. It is evident that it has not always been such a choice, but in many instances men have dignified themselves and the farm by deliberately choosing to lead an independent life rather than to rush into the miserable artificialities of much of our city life. It is to the population capable of such a choice that we must look for the elements that will check the too strong current away from the farm.

(2) This tendency is increased, in my judgment, by the fact that fewer men are needed in agricultural pursuits. The improvement of machinery has done something to intensify farming at certain periods of the year and rendered it unnecessary to keep a large force of men constantly available. The law of supply and demand would therefore cooperate to reduce the rural population. On the other hand, the multiplication of machinery in civilization has increased the demands for men through the opening up of so many new methods of business. The modern methods of transportation have reduced the hours of labor, and the specialization of labor has combined to give the laboring population a larger share in the earnings of society and a wider distribution of these earnings. We must recognize also that the improvement of farm machinery has greatly increased the investments necessary for successful farming. Not

every man can afford these investments. He may not be prepared to use them intelligently and therefore profitably. The result is in many communities that we have a large number of sales annually. Men whose lives have been spent in rural pursuits restlessly turn from the farm to ordinary labor as a means of livelihood. The result is an absenteeism on the farm. City men and men of some means have been buying land either as a safe or speculative investment. The result is a species of landlordism on the one hand and of inferior farming on the other. Under such conditions it may not be expected that renters' sons will remain on the farm and become the sturdy yeomanry of the country. Neither is it probable that the children of these people will manifest any great interest in agricultural education. There is a manifest tendency toward intelligent farming. It is evident that the old methods are often expensive to the point of wastefulness. Men lacking education are not profitable even as employees. Much less are they capable of satisfactory service as farm managers for owners of land. Such people are now moving to our cities for ordinary day labor, in the hope that their children may sometime become clerks or subordinates in the great whirl of commerce. They are unfit for the farm, are prejudiced against it, are unwilling to fit themselves for it, and eventually swell the population that inhabits the cheapest quarters in our cities or ekes out a miserable existence in a small village. Such people are not needed on the farm, and eventually they become superfluous in the town or city.

(3) A third specification among these conditions lies in the difficulty in bringing town or city people to rural life. They are quite willing, many of them, to live at a convenient distance from the city with a large investment in a small area of ground for personal comfort and a certain type of luxury that only the country can bring, but they are not easily brought to do the actual farm work necessary for the development of agriculture. We can not conceive of a country as a city, made up of town lots of 10 to 20 acres in area. The truth is that the city-bred people have little conception of what rural life really is. Many of them have an exaggerated prejudice concerning it. The training in action, associations, exciting amusements, and all that go to make up the externalities of city life unite to unfit an individual for the peaceful pursuits of rural living. Whatever hope there is, therefore, for the rural districts must eventually come from the rural districts themselves. It is to the population on the farm that we must turn for the perpetuity and improvement of rural life. The record made in the past by choice rural individuals in the city has greatly helped and improved the city. I see no evidence that the city will ever help or improve the country. The agricultural college, therefore, will find one of its most pressing and important problems in the country itself. It may be very entertaining and quite fashionable to chat in a city parlor about the beauties of agriculture, but the real problems of agriculture are on the farm and not in the drawing room.

(4) A fourth specification is the question of profits. There is no doubt that men desire to make money and that the profit in farming determines the attitude of many for or against this pursuit. Many young men leave the farm because they see that their fathers have spent a life without accumulating much money and because the fathers oftentimes complain that they have not made money. It is not uncommon under these conditions to see a greatly impoverished farm associated with an unfilled purse. As an individual question, we can not blame any man for having a desire for an improved condition. We can not ask him to stay in a place where there is no prospect of improvement. If he were willing to do this he would be fitted neither for a farmer nor for a business man. It is not, therefore, the personal phase of this question that I am now suggesting. It is rather the general question of profit in farming as having to do with the tendency away from the farm. We recognize that the speculative values in farm lands constitute no part of ordinary farming. The man who buys cheap land at $10 per acre and holds it for ten years and finds it worth $30 per acre has not made money by farming; he has made money by speculative investment in farming lands. As soon as it is realized that this speculative value is an uncertain quantity the attractiveness of such investments ceases. Multitudes of farmers can not be and ought not to be speculators; they should be farmers, and the problem is to make them profitable farmers. In the consideration of this question we must recognize the impoverished condition of much of the farming land of our country. To be sure we have recognized this as a fact. I appeal now to recognize it as a condition; a condition that threatens the permanent usefulness of the farm and the farmer. I find a very widespread belief that much of our farming land never can be made profitable for the individual farmer. If this is a permanent condition our colleges and experi-

ment stations should take the lead in making those things known and in bringing the Government to a realization of that condition. Surely this impoverished soil has some place in the national economy. There is some way of turning it to good account. The law of diminished returns as set forth in our standard works of political economy makes it entirely clear that the scale of wages is determined by the land cultivated without profit, or, to put it in another way, the land cultivated at the highest rate of expenditure. In my judgment the permanently profitable condition of farm land is considerably menaced by the area of impoverished soil in the country. So far as my observation goes, but little attention has been given to this condition as influencing the general conditions of rural life. I am persuaded, however, that it not only tends to keep down farm wages, but that it harbors an inferior population and from nearly every point of view threatens the most important conditions of rural life.

I recognize, however, that not all of this impoverished soil is hopelessly so. This leads me to say that intelligent operation of the farm is necessary for any margin of profit. This intelligent operation and management is impossible without education. Some farmers have learned the lesson of profitable farming after an experience of twenty-five years. That experience was valuable, but a very expensive education. The purpose now is to give to the young farmer, while in his teens, an education that will enrich him with the experience of other men gained after a long period of years. In other words, he is asked to invest very much less money in his education than he will pay for his experience. At the same time his era of profit will begin at 25 instead of at 50. The movement for agricultural education is still in its infancy. We are still in the apologetic stage. We need a propaganda accompanied by a demonstration that shall convince men that intelligence properly applied will produce results on the farm just as certainly as elsewhere.

As bearing upon this question of profits I recognize that there are other elements. The question of markets, their availability, the long or short haul, good roads, methods of transportation, and similar elements often enter into the question of the profit of agriculture. The tendency up to date has been to lay the entire burden of all these things upon the local community. It may be that it shall always remain so. This may add to the expense of local production while not making it clear that some obscure places are in any better condition.

The above-named particulars are sufficient to arouse our thought as to the seriousness of the condition that confronts a growing civilization. If conditions were not serious there would be no necessity for much ado about the importance of agricultural education or the necessity of government aid in such matters. The seriousness is not a new phase of the condition. The only thing new is that the recognition of this condition is more general than heretofore. The awakening among us of our convictions upon this subject, accompanied by a general desire to make such improvement in conditions as shall largely justify our efforts, is a most encouraging feature. This is justification for a stronger appeal that I can not make to the representatives of the great cause of technical and industrial education. Let me bring renewed emphasis, therefore, upon one or two things as we move along.

III. I refer to the well-recognized problems of connecting education with farming. All here agree that we have passed the time for unintelligent farming. Indeed, it would have been better if we had never reached that time. The fact remains, however, that a large portion of the agricultural work of the country has been a blind trust in the moon, or in Providence, or in luck. The multitudes, however, have long believed that the farmer's boy needed an education if he proposed to be a lawyer or a minister. We appeal for an equally abiding conviction that the boy who is to be a farmer must have an education. The one idea seemed to be that the only way to learn to do a thing was by doing it in an unintelligent and expensive way. The modern idea is that we shall learn to do things by doing them under competent supervision and in a most economic way. The agricultural college therefore is an expensive thing in itself, because it centralizes all the expensiveness of ignorance under an organization that proposes to remove ignorance and supplant it with intelligence and skill. The fallacy that unintelligent men can do farm work needs to be entirely removed. The truth is that it requires less intelligence to dig a ditch for a sewer in the city than to prepare for a tile drain on the farm. In the one case there is an association with other laborers, the foreman, and a large amount of concentrated supervision. In the other case there is no such association, but a demand for intelligence that can supervise itself. Even the ordinary operations of the farm require men who are equal to their own emergencies and who can assume their own responsibilities. In the larger questions of farm economy, farm management, and the many problems that have been so interestingly discussed in the meetings of this association there is call for a grade of intelligence, of executive ability, and of management much higher than is ordinarily appreciated.

IV. Another phase of this appreciation lies in working out an educational programme that shall do the thing desired. This association has already discussed and in general decided the main features of what, in its judgment, an agricultural education should be. Considerable time and labor have been spent upon the classification and adjustment of subjects and the time to be given to these several subjects. There is now general agreement that this work has been well done. I do not look for any serious or revolutionary modification of this programme. The problem seems to be one of natural and, as I think, necessary expansion. I should not ignore the criticism that has been made of agricultural colleges, although I do not desire to be understood as supporting it. Some of it has been intelligent, wise, and helpful, but much of it has been erratic, zealous, and ill-informed. It has been said that agricultural courses are not well adapted to the ends desired. It has been intimated that our courses of study do not carefully conform to the spirit of the Morrill Act. It has been said also that they do not meet the most pressing needs of the agricultural classes. These are serious statements and in a way constitute a charge against intelligence or the intelligence of those to whom the oversight of these colleges is intrusted. So far as these objections have any force it may be found that a more generous provision of money would remove most of them. Agricultural education is working under very serious limitations. Most people and a very considerable percentage of legislators have failed to appreciate that agricultural education is of necessity expensive. It is to be expected that every effort, however sincere, can not always be wisely directed. We may therefore look for some unwise use of money and for the abandoning of certain lines of work. Making due allowance, however, for all these things, there remains the outstanding fact that the limitations of these colleges have been a serious handicap. Those in the association who have had most generous support have proved to be most largely serviceable not only in their own States, but to the general cause of agricultural education. In the present programme of this association we are to discuss a number of the questions that bear upon this very problem. Whether these colleges shall do elementary work or whether they shall do more advanced work will in many instances resolve itself into a question of money. There is a sentiment in the country that these schools should confine themselves to what might be termed "practical education." We hear it and read it in the press that there is no great demand for scientific agriculturists—at any rate, that such demand could be met by a few colleges. We are told that the higher and more scientific pursuits should not be abandoned, but that the more important and practical phases of agriculture should be emphasized and the work in that direction greatly enlarged. Certain phases of agricultural effort, like the agricultural institute in Iowa and the winter schools in Wisconsin and Minnesota, have attracted considerable attention and called forth much praise. The tendency, especially in the West, to take active interest in stock exhibits is quite marked. On the other hand, severe criticism has been brought upon agricultural colleges for experimental feeding, which costs three or four times what the stock market will support. We have heard it said that such education would pauperize every farmer in the State.

I mention these things not for approval or disapproval, but for the purpose of calling attention to the fact that the programme of the agricultural colleges is not yet in its final form.

I call attention to another fact in connection with it, that all these special features are expensive. The taxpayer is not exclusively devoted to the cause of agricultural education. We shall probably not reach a point very soon where we shall be free from adverse and oftentimes captious criticism.

V. As bearing upon this general topic and as presenting another specific problem, I make reference to the movement for agricultural education in the rural schools. In general this is the outgrowth of the agricultural college and follows the line of other educational development in that most improvement has come from above. The highest education has stimulated the elementary education. It is natural, therefore, that the agricultural college should stimulate the elementary education in the rural schools. This is more than a passing phase of the subject of nature study. The local influence of a school should always be for the improvement if its constituency. There is no place where more widespread good can be done for agriculture than in the rural schools. What might be termed agricultural extension work might well be the subject for considerable thought by every agricultural college of the country. If it be true, as I think we all agree, that one of the great functions of the agricultural college is to arouse and maintain such an interest in agricultural pursuits as shall commend them to the rural population, I think we shall also agree that the teaching of agricultural science in the rural schools would be a splendid appetizer for an agricultural education. The need of this becomes more imperative when we recognize that agriculture differs from many other pursuits in that it is not disposed to take care of itself. The engineering interests of the country, the banking interests, the business interests are alert and awake. We may depend upon them to take care of themselves. Every college of engineering in the country looks carefully to the commercial demands that are made upon its graduates. The standard of education, the subjects to be pursued, the kind of instruction to be given are largely determined by commercial conditions. If this is true so far as agriculture is concerned, the country has not waked up to it. It seems incumbent, therefore, upon the teachers of agricultural education to carry on a propaganda. We can save the business of agriculture to our best people only by putting it on a plane where the best people are demanded in its management. The recompense of reward must not be entirely forgotten in the adjustment of this problem. I look, therefore, for a future adjustment in our programme of studies that shall make provision in our colleges for a department devoted to the expansion of agricultural education among the rural districts. This work will not be confined to efforts in the rural schools, but will be somewhat parallel to the correspondence work now carried on in engineering lines and indeed in many literary lines. The problem of agricultural education will not be solved until the agricultural colleges have been brought into close and vital relation to the agricultural populations. This touch with the agricultural population I regard as of more vital importance than touch with the schools.

VI. I suggest another phase of this problem in the adjustment of the subject of military instruction in the colleges. I recognize that this subject is up for discussion in the programme of this meeting and introduce it here with no desire to encroach upon that discussion, but for the purpose of bringing it to your consideration in some of its general features as observed in my own experience. What is known among us as "General Orders, No. 65," has forced this question to the attention of many of the schools. Reports from Washington are to the effect that this order is not complied with in a number of the colleges. An investigation into the work actually done raises the issue whether General Orders, No. 65, is in accordance with the Morrill Act. That act, as generally understood, makes military tactics mandatory in all these colleges. The extension of the education therein provided is a matter of subsequent development and should be given consideration in connection with the chief idea of the Morrill Act. It seems incumbent, therefore, upon these colleges, and perhaps upon this association, to seek for a clearer definition of the duties imposed upon the land-grant colleges by virtue of the Morrill Act. The act provides that certain subjects, including military tactics, should be taught. The Government has never undertaken to determine in what manner any of these subjects shall be taught or the extent of the teaching, or in any way to suggest a schedule, except in the case of military tactics. This has been undertaken by the Department of War, but I am at a loss to discover any warrant in law for much that is contained in the latest order issued to these colleges.

Without attempting to direct the association, I suggest that it is well to consider here whether the general idea of these colleges be in industrial education rather than military education. If I am correctly informed, a literal compliance with General Orders, No. 65, will occupy about one-half of each day in the week throughout the entire year. The assignment to colleges is usually limited to the detail of a single officer. Where the attendance is large and where, as in the case of the institution in which I serve, there are as many as 800 and sometimes more in the cadet battalion, it is manifestly impossible for any single officer to perform all the duties in connection with military tactics. The cadets in these institutions are not competent to take the place of instructors. All that can be expected of such cadets would be ability to control in the ordinary movements of company and battalion drills. Moreover, there is necessity of a constant change in the roster of the cadet officers, thus making their efficiency more questionable. The more theoretical and general topics suggested for instruction are manifestly impossible for such officers. The instruction of the officers and non-commissioned officers of the organization at the Ohio State University gives the commandant a class of more than one hundred men. Manifestly that is more than a single officer can do if he is to meet the requirements laid down. I assume that the idea of military education as set forth in the Morrill Act was to lay the foundation for the making of soldiers, and not the technical education of army officers. The amount of work, the kind of work required, and all other such questions, therefore, should be determined not by an army ideal, but by the conditions under which these colleges must work. It would seem, therefore, that a complete military education is out of the question, and that the work should confine itself to the teaching of the important and fundamental principles only.

Not wishing to discuss this question at all in detail, I mention it here for the purpose of suggesting to the association the necessity of a careful consideration of the place that military tactics should occupy in our programme of subjects. There is manifestly no uniformity of practice among the colleges. Moreover, the War Department has insisted upon a strict compliance with General Orders, No. 65. In former years this association has waited upon the authorities with reference to this subject. It would seem now more than ever incumbent upon us to make further investigation of the subject and for the association to take up such methods as shall bring about a general uniformity. This matter, in my judgment, should not be left to a single-handed controversy between a particular college and the War Department.

By way of conclusion, I now desire to suggest to the association that the expansion of the type of education for which these colleges stand is a pressing necessity. The more civilization itself develops the more imperative will be the demands for education. Moreover it is to be expected that with the development of civilization the expenditure for protective purposes will relatively decrease, while the expenditures for the developmental functions of the Government will steadily increase. Education is the most important of all the developmental functions in which the Government engages. I lay it down, therefore, as almost a self-evident truth that the tendency of the State in the matter of education is permanent and that the extent of the work is sure to increase. This applies to the movement for public schools, for State universities, and for all other types of public education. Now, these land-grant colleges, whether separate institutions or whether associated with State universities, represent a distinct type of education, whose importance will not decrease, but whose work will expand with the development of our civilization. Indeed, a good argument could be made to show that these colleges are more closely related to the progress of civilization than any other type. But passing that argument, I wish only to impress upon ourselves at this time the fact that we are engaged in a work that shall be greatly increased in the future. There ought to be, therefore, more concerted action possible among these schools. At any rate I suggest that there ought to be from this time on a vigorous discussion of our relation to the expanding civilization in which we live and of the ways and means by which these colleges shall be brought to the highest efficiency. The States should be brought to realize that all provisions for these colleges are for the present only. They are a part of the State and of the nation and are truly national colleges located within the States for national development. Their future is certainly an increasing one and their needs will steadily increase. Let us appreciate our opportunity and bring to the people of this country a realization, not only of the importance of the work done, but the duty of giving these colleges adequate support.

On motion, the convention adjourned to meet the next morning at 9 o'clock.

MORNING SESSION, WEDNESDAY, NOVEMBER 2, 1904.

The association was called to order at 9 o'clock a. m. by the president.

DEATH OF MAJOR ALVORD.

H. C. WHITE. The executive committee called attention in its report yesterday to the sad occurrence of the death of Major Alvord. I now move that a committee of three, consisting of President Patterson, of Kentucky; Director Henry, of Wisconsin, and Director Armsby, of Pennsylvania, be selected to prepare suitable resolutions of regret concerning the death of Major Alvord.

The motion was seconded and carried.

ADAMS BILL AND MONDELL MINING SCHOOL BILL.

H. P. Armsby, of Pennsylvania, offered the following resolution:

Resolved, That the executive committee be instructed to continue its efforts to secure the passage by Congress of the bill increasing the appropriation to the agricultural experiment stations and the mining school bill.

On motion of W. A. Henry, of Wisconsin, the executive committee was instructed to appoint a time for the discussion of this subject (see p. 64).

STANDING COMMITTEES.

The question of the status of standing committees was briefly discussed and the matter was referred to the executive committee for report at the next convention.

METHODS OF TEACHING AGRICULTURE—THE TEACHING OF AGRICULTURE IN THE RURAL SCHOOLS.

The report of the committee on this subject, which discussed "The teaching of agriculture in the rural common schools," was read by H. T. French, of Idaho, in the absence of the chairman of the committee, A. C. True, as follows:

In accordance with the apparent wishes of the association as expressed in an informal discussion of the report of this committee at the meeting in Washington last November, this ninth report of the committee on methods of teaching agriculture[a] is devoted to a discussion on the feasibility of teaching agriculture in the rural common schools, and suggestions regarding the nature and extent of such teaching. In this discussion the term "common schools" is taken to mean schools giving instruction in grades below those of the high school, and the term "rural schools" will include not only the schools in extremely rural districts, but also those in villages and small towns which draw largely on the adjacent country for pupils and financial support. It should also be understood that in this report attention is confined to matters relating to the teaching of agriculture in the rural schools as ordinarily organized in our public school system. We have not undertaken here to discuss the advisability of the establishment of county or district elementary schools of agriculture as separate institutions or the courses of instruction suitable for such schools.

DEVELOPMENT OF INDUSTRIAL TRAINING IN THE COMMON SCHOOLS.

Industrial training as a subject for regular instruction in the common schools has been until recently confined largely to manual training in the city schools, and even in these schools it is still far from being fully developed. However, the number of schools in which manual training (other than drawing) is given has increased rapidly during the past thirteen years. In 1890, when the Bureau of Education first began publishing the statistics of manual training in the United States, there were only 37 cities of 8,000 population and over in which manual training was taught in the public schools; in 1902 there were 270 such cities. The schools referred to are those in which other subjects than manual training are mainly taught.[b] In 25 of these schools manual training is given in all grades, including the high school; in 64 it begins with the first grade; in 33 it is confined to the high school, and in 206 (more than three-fourths of all the schools) it is given in some of the grammar grades.

The introduction of manual training into courses of study which were already crowded has involved problems requiring close and careful study of the needs of the pupils, and has generally resulted in greatly increasing the efficiency of the schools in which manual training is now taught. The effort has been made to retain all the essentials of the branches commonly taught in such schools and add the manual training. This has been done by a careful grading of the pupils, by securing better teachers and text-books, and by judicious and careful elimination of the nonessentials in the various branches.

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[a] For previous reports see U. S. Dept. Agr., Office of Experiment Stations Buls. 41, p. 57; 49, p. 29; 65, p. 79; 76, p. 39; 99, p. 86; 115, p. 59; 123, p. 45; 142, p. 63, and Circs. 32, 37, 39, 41, 45, 49, and 55.

[b] There were also, in 1902, 163 schools devoted chiefly to manual and industrial training.

The time to be given to manual training, so that it will not interfere with efficient instruction in other branches, has been carefully considered, and experiments with regard to this have been tried. Some idea of the time occupied by manual training in some of our larger cities can be gained from the following statements: In Boston 2 hours per week are devoted to manual training throughout the fourth to ninth grades, inclusive, the boys having drafting, woodworking, and clay modeling, and the girls sewing and cooking. Manual training in the schools of New York City extends through seven grades, with a total of 4 hours per week for both boys and girls during the first 5½ years, and 4½ hours during the second half of the sixth year and all of the seventh year. In the seventh and eighth grades of the Washington schools the girls have one 2-hour exercise a week in cooking and sewing, and the boys a similar period in woodworking. In Allegheny the boys have shop-work 2½ hours and drawing 1½ hours a week for 3 years, and a supplementary course of 1 year. In Toledo each ward school has one manual training period of 1¼ hours a week. The time devoted to manual training in Los Angeles is two 20-minute periods a week through the first four grades, and three 25-minute periods throughout the next four grades. The work includes paper folding and cutting, raffia work, reed basketry, cardboard construction, sloyd, drawing, shop practice, sewing, and cooking. In San Francisco manual training for boys includes one lesson per week of 50 to 60 minutes in the seventh and eighth grades. Comparatively few of the schools having manual training give less than an hour a week to this work, and the great majority allow 2 or more hours for it. In most cases the work extends over 3, 4, or more years. The average cost of the plant for manual training in the 270 cities reporting work of this kind in 1902 (not including manual training high schools) was $20,000, making a total investment for this purpose of $5,400,000. The current expenditures for teachers, materials, tools, etc., in 1901–2 were nearly $1,000,000.

MOVEMENT TO INTRODUCE AGRICULTURE INTO THE RURAL SCHOOLS.

More recently there has developed a movement to introduce the elements of agriculture into the rural schools. This movement has been largely an outgrowth of the nature study movement which for a number of years has been encouraged by such agencies as the Cornell University Bureau of Nature Study and the agricultural colleges in a number of other States, as well as by many prominent educators connected with other kinds of schools and colleges. Then came the school garden movement, and in this as in the nature study movement the city schools have led those in the country, partly because the children in the city schools have taken a greater interest in such work on account of its novelty to them, and partly because the city schools through better organization and equipment and special teachers have been able to make experiments of this kind more readily than the rural schools. In these experiments, as might have been expected, mistakes were made. Nature study, according to some of its advocates, was to be elementary science, with a long list of scientific names, with classifications based on stipules, scales, and caudal appendages, and with a "why" for everything. It involved such a universal knowledge of science that teachers were appalled at the prospect of having to prepare for the innovation. On the other hand, some of the advocates of nature study would have no formality, no classification, no plan—whatever came to hand was a subject for nature study. Facts were to be learned, not because of any bearing that they might have upon the symmetrical development of the children's faculties, but simply because they were interesting. There was no logical beginning to such study, no pedagogical sequence, no end. Fortunately there were other teachers and students of education who took neither of these extreme views, but who saw in nature study an opportunity to bring the children into more sympathetic and helpful relations with their natural environment, and at the same time increase their fund of useful knowledge. These teachers, when located in city schools, have brought to the consideration of their nature study classes the trees, shrubs, flowers, and vines found around the city homes, in the parks, and in the lawns, and have studied the insects, birds, and other animal life of the city in relation to this plant life. In the country they have considered the plants, animals, birds, and insects which surround the farmer and aid or hinder him in his work, giving much attention to their economic importance and very little to any marked peculiarities they might chance to possess. Such nature study forms an excellent basis for the subsequent study of more formal agriculture. It has been tried in both city and country schools, and has been found to furnish not only a means for arousing and sustaining the interest of the children, but also through its economic limitations an outline sufficiently definite to enable the teacher to know where to stop, and yet sufficiently flexible to enable her to adapt it to local conditions.

Nature study such as this, having an agricultural trend, is about all that has been attempted in the way of teaching agriculture in the rural schools until quite recently. Within the past two or three years, however, State superintendents of public instruction, the officers of some of the agricultural colleges, the National Educational Association, the American Civic Association, as well as a number of other organizations and numerous individuals in various official positions have interested themselves in the introduction of elementary agriculture and gardening in the rural schools. The National Educational Association now has a special committee of educators of national repute considering this subject. The American Civic Association has one department devoted to children's gardens and another to rural improvement. Last June, in Chicago, an organization known as the American League of Industrial Education was organized to—

"conduct an educational campaign for an industrial public school system which should include the teaching of domestic science and both agricultural and manual training in all public schools; * * * to promote the establishment of school gardens in connection with all public schools, where every child would be taught to be a lover of nature and of the country, and trained toward the land as a source of livelihood rather than away from it; * * * to advocate the establishment of public manual training school farms in every county in the United States and of as many such manual training school farms in the vicinity of all cities, by State, municipal, and national governments, as may be necessary to give to every boy the opportunity to learn how to earn his living by his labor and to till the soil for a livelihood and get his living from the land."

Some of the State school authorities, officers in agricultural colleges, and county superintendents of schools have prepared outlined courses in agriculture which have exerted a strong influence toward the teaching of agriculture in the rural schools. Such courses have been prepared, for example, in Missouri, Illinois, and Indiana, and for a group of schools under one superintendent in Durham, N. H., and vicinity.

The Illinois course in agriculture was prepared by the dean of the college of agriculture, and gives the following reasons for teaching agriculture in the public schools:

"(1) To cultivate an interest in and instill a love and respect for land and the occupation of agriculture.

"(2) To create a regard for industry in general and an appreciation of the material side of the affairs of a highly civilized people.

"(3) To cultivate the active and creative instincts as distinct from the reflective and receptive that are otherwise almost exclusively exercised in our schools.

"(4) To give practice in failure and success, thus putting to the test early in life the ability to do a definite thing.

"(5) To train the student in ways and methods of acquiring information for himself and incidentally to acquaint him with the manner in which information is originally acquired and the world's stock of knowledge has been accumulated.

"(6) To connect the school with real life and make the value and need of schooling the more apparent.

"(7) As an avenue of communication between the pupil and the teacher, it being a field in which the pupil will likely have a larger bulk of information than the teacher, but in which the training of the teacher can help to more exact knowledge."

The course is arranged by months, and gives suggestions for a large number of experiments and observations bearing on all the divisions of agriculture. Considerable reading along agricultural lines is suggested, as well as drawing, composition, and other work intended to correlate agriculture with other school work. All technical words likely to be used frequently in this connection are defined.

This course has been in the hands of Illinois teachers one year, and the superintendent of public instruction reports "an increased interest throughout the State in the study of agriculture." He says:

"In nearly every county in the State a good beginning has been made, and in several counties the interest and progress has been little less than remarkable. In many rural schools the subject is being studied, following the outline found on pages 166–180 of the Illinois Course of Study for the Common Schools. Some of the graded schools are doing systematic and intelligent work along this line and are conducting in connection with the schools successful school gardens. That the interest is growing is shown by the many thousand requests for corn and seeds, which are received by the secretary of the farmers' institute."

According to statistics collected by the superintendent of farmers' institutes in Illinois, fourteen counties report that in nearly all the schools agriculture is being taught as suggested in the State Course of Study, and in fifteen other counties a majority of the schools are attempting this work.

In addition to agricultural work in the schools of Illinois, considerable is done by the State College of Agriculture, the superintendent and the secretary of farmers' institutes, and county superintendents of schools to arouse an interest in farm life by means of clubs of farmers' boys, which are organized in the different counties for the purpose of conducting experiments at their homes in testing improved varieties of corn and sugar beets. These clubs hold regular meetings similar to farmers' institutes, and once a year are given places on the programmes of the county farmers' institutes. Several of these clubs have had lecture courses, with lectures from men prominent in the agricultural colleges and experiment stations, and some of them have gone on excursions to different agricultural colleges. Eight thousand of these boys exhibited corn of their own raising at the Louisiana Purchase Exposition, and 1,250 of them drew prizes ranging from 50 cents to $500. The girls have similar organizations, which are devoted to the consideration of subjects relating to the farm home.

Similar organizations of boys and girls are also found in Iowa, Ohio, and Texas, all of them organized under the auspices of the State agricultural colleges or of agricultural journals. The membership of the boys' and girls' clubs in Ohio is nearly 2,000 and in Texas over 1,200, though the latter organizations are little more than a year old. Everywhere that work of this kind has been done it has seemed to meet with enthusiastic approval. The boys and girls take pride in their organizations and in doing in a small way what their parents do more extensively.

In Missouri the course in agriculture for the public schools was prepared several years ago by the State superintendent of schools. This course has been superseded by a bulletin prepared by the State superintendent of schools and published by the Missouri State Board of Agriculture in September of the present year, entitled "Elements of Agriculture for the Public Schools." This bulletin advocates presenting the subject of agriculture "(1) by experiments at home and in the field, (2) by studying facts as given in texts and bulletins, and (3) by school gardens connected with school grounds."

"Teachers are advised to utilize school grounds or gardens near the school as experiment stations, to have pupils experiment at home and make field observations, and to secure bulletins from the Department of Agriculture, at Washington, D. C., from the Missouri State Board of Agriculture and from the agricultural college, both at Columbia. The school library should have copies of several good texts. Appeal to the pupils' interests along all lines and enlist the cooperation of the parents."

The course in agriculture, as outlined in the bulletin, includes (1) studies on soil—origin and composition, kinds, plant food, improvement, rotation of crops, and experiments; (2) roads—value of good roads, road drainage, artificial roads, good dirt roads, influence of roads, road laws, and experiments; (3) studies on seeds and related subjects—germination, vitality, and parts of seeds, with experiments in corn planting, corn growing, corn judging, selecting seed corn, and observations and experiments with corn (similar treatment of wheat); (4) studies of plants—their classification, relation to soils, buds, twigs, etc.; (5) orcharding and gardening—apples, grapes, berries, home gardening, commercial gardening, enemies to gardens; (6) study of insects; (7) stock raising and feeding—horses, mules, cattle, sheep, hogs, and domestic fowls. Numerous experiments and observations are suggested throughout the bulletin. Two bulletins have also been issued by the College of Agriculture of the University of Missouri which are intended for use in the public schools. One of these is on Plant Propagation and the other on The Principles of Plant Production—the Seed.

The superintendent of public schools, the College of Agriculture, and the State normal schools in Missouri are cooperating in agitating the introduction of agriculture into the public schools throughout the State. This is done by addressing teachers' institutes, farmers' institutes, and other public meetings; by conducting summer schools for teachers at the College of Agriculture, in which special attention is given to courses which will prepare them for teaching agriculture, and by conducting regular courses in agriculture at the three State normal schools.

The State superintendent of public instruction of Indiana, in his State Manual and Uniform Course of Study for the Elementary Schools of Indiana, 1904–5, includes a nature-study course intended "to acquaint the pupil with his environment and to train him to see and understand the relationship and meaning of common things," and a course in elementary agriculture. The subjects suggested for consideration in the nature course are largely the plant and animal life of the farm and the garden. The course in agriculture is simply an outline intended to guide the teacher, taking up for first consideration plant and animal products; then the soil, its formation, nature, tillage, and enrichment; and, finally, plant life. References are given to a number of bulletins and elementary text-books of agriculture.

The department of agriculture of the University of Minnesota has been actively engaged in promoting the teaching of agriculture in the rural schools, and its officers have prepared a bulletin on Rural School Agriculture for the use of the teachers in that State. In Wisconsin the State superintendent of the public schools and the officers of the College of Agriculture of the University of Wisconsin have done much for the introduction of agricultural teaching in the country. One of the results of their efforts has been the enactment of a law requiring teachers to pass examinations in agriculture. Similar laws have also been enacted in Maine, Nebraska, North Carolina, South Carolina, and Tennessee.

The training of teachers along agricultural lines is receiving considerable attention not only in Missouri, as mentioned above, but also in other States. The College of Agriculture of Cornell University now provides a two-year normal course in nature study and gardening. In Michigan ten county normal training schools have recently been opened for the purpose of training teachers for the rural schools. The course of study recommended for these normal schools by the State superintendent of public instruction includes agriculture. The agricultural colleges in Connecticut, Nebraska, and North Carolina have for a number of years conducted summer schools for teachers, at which more or less attention has been given to nature study and agriculture. At the Nebraska summer school in 1904 there were 23 students in nature study and 30 in agriculture. At the North Carolina summer school for teachers in 1904 there were enrolled 977 teachers, of whom 477 took work in agriculture. The summer school of the South, conducted at the University of Tennessee with an annual attendance of from 1,000 to 1,300 teachers from all parts of the South, gives considerable attention to nature study and gardening.

One thing that has given a great impetus to the movement for the introduction of agriculture into the public schools has been the improvement of text-books and works of reference. Within the last year or two a number of elementary text-books in agriculture have been published, and some of these seem very well suited to use in the rural schools. One of the indirect results of the appearance of these text-books has been legislation in a number of States requiring the teaching of agriculture in all the rural schools, and adopting text-books for that purpose. State adoption of text-books in agriculture has been made in Alabama, Georgia, Louisiana, North Carolina, and Tennessee. Every city and county in Virginia, a majority of the counties in Maryland, about 15 counties in California, and a number of counties in Florida have also adopted text-books in agriculture for regular use in the public schools. It is estimated from teachers' reports that at least 12,000 children received instruction in agriculture in North Carolina last year. Thus it will be seen that there is quite a strong movement for the introduction of agriculture into the rural schools and that this movement is rapidly gaining momentum.

OBSTACLES TO THE GENERAL INTRODUCTION OF AGRICULTURE INTO THE RURAL SCHOOLS.

There are many things which have a tendency to hinder the rapid progress of this movement. One of these is the conservatism or apathy of school officers. This applies not only to local officers but also to State superintendents of public instruction, county superintendents of schools, and the officers of agricultural colleges in many of the States. Some of these officers doubt the possibility or wisdom of teaching agriculture in the common schools on account of the lack of text-books, or the lack of trained teachers, or for some other reason. It is, however, a notable fact that in the States where such officials are cooperating actively and earnestly in conducting a lively campaign along these lines, agriculture is actually being taught with considerable success, and teachers who feel that they are unprepared in this branch are flocking to summer schools, where they can make the necessary preparation.

Another difficulty is that the teachers in rural districts are mostly women with little or no normal training either in the ordinary branches taught in the common schools or in special subjects. There is no teaching profession in the rural schools. The salaries are so low that they do not attract those who have prepared themselves for the profession of teaching. As a consequence, most of the teachers found in rural schools are beginners or those who have not been sufficiently successful to be called to positions offering a higher salary. Most of the men who are teaching in the country are doing so merely for the purpose of raising money to go away to school or to go into business.

These conditions result in a rapid shifting of teachers from school to school, which is another serious drawback to progress of any kind. Again, the terms of school are too short. When a child can go to school only four or five months in the year there is little time in the few years that he is in school for the study of other subjects than reading, writing, arithmetic, geography, and history. Before much progress can be made in the introduction of agriculture into the rural schools much must be done for the general improvement of those schools. This improvement will be brought about partly by remedying the conditions already mentioned in the school districts as they are now organized, and partly through the consolidation of small districts and the organization of centralized schools, including rural high schools where village high schools are not readily available for those who can go beyond the grammar grades. The practice of consolidating schools has already been resorted to in California, Colorado, Connecticut, Florida, Georgia, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Vermont, Washington, and Wisconsin. Notable movements toward the consolidation of schools have recently been inaugurated in Louisiana, Missouri, and North Carolina. While this movement toward consolidation has spread to all parts of the country, there are relatively few localities in any State in which the system has been adopted and brought into working order. Hence the full effect of this important change in school policy has not been felt, even in the States where consolidation is a feature.

In the localities where consolidation has been thoroughly tried, however, it has usually met with general approval. It has enabled the school officers to grade the schools more effectually, thereby opening the way to greatly enriched courses of study; to lengthen the term of school; to employ better teachers at higher salaries and keep them for a number of years, and to employ several teachers instead of one, each to give instruction in only a few subjects or to only two or three grades, thereby opening the way to the more continuous and profitable employment of the pupils' time. It is notorious that in the ordinary country school, where the teacher has from 25 to 30 recitations in a day and can not personally direct the study of the children, the latter waste fully half of their time in idleness or mischief-making. This and many other defects of the rural common school are remedied by consolidation, and the transportation of pupils from distant parts of the district at public expense is accomplished at no additional expense per unit of attendance. The Commissioner of Education, in his annual report for 1903, says: "The possibilities of consolidation in the way of furnishing better and cheaper schools have been fully demonstrated, and such being the case its general adoption would seem to be only a question of time."

While consolidation opens the way for the more general introduction of courses in agriculture in the rural schools, it does not help supply the demand for teachers competent to give such special instruction. This can only be done by a more general and concerted effort on the part of the agricultural colleges and schools and the State normal schools, at present through the introduction of short and special courses in agriculture for teachers, and later through regular normal courses in agriculture.

Fortunately, the attention of the general school officers throughout the country is now being strongly drawn toward the needs of the rural schools, and in many States strenuous efforts are being made to improve the general condition of these schools. Our urban communities are coming to see more clearly that their prosperity is vitally associated with the prosperity of agriculture, and they therefore more readily assent to State taxation for the benefit of the rural as well as the city schools. Advantage should be taken of the increased prosperity of many of our agricultural regions to impress upon our farmers the wisdom of building better schoolhouses, improving the school grounds, increasing the pay of teachers, and introducing the teaching of agriculture in the country districts as an investment which will greatly aid in perpetuating and increasing the prosperity they now enjoy and make the lot of their descendants more fortunate than their own. The agricultural colleges and the farmers' institutes can have great influence in this direction.

OBJECT OF TEACHING AGRICULTURE.

Coming now to consider what should be the aim of instruction in agriculture in the elementary school and how it should be related to the general scheme of elementary education as formulated and approved by educational authorities, we have for our guidance the report of the Committee of Fifteen of the National Educational Association. In this report it is assumed and argued that the studies of the school fall naturally into five coordinate groups: (1) Mathematics and physics; (2) biology, including chiefly the plant and the animal; (3) literature and art; (4) grammar and the technical and scientific study of language; and (5) history and the study of sociological, political, and social institutions. Dr. W. T. Harris, U. S. Commissioner of Education, in a paper discussing this report and the necessity for five coordinate groups of studies in the schools, says:

"Each one of these groups, it was assumed, should be represented in the curriculum at all times by some topic suited to the age and previous training of the pupil."

Continuing, he says:

"The first stage of school education is education for culture and education for the purpose of gaining command of the conventionalities of intelligence. These conventionalities are such arts as reading and writing and the use of figures, technicalities of maps, dictionaries, the art of drawing, and all of those semi-mechanical facilities which enable the child to get access to the intellectual conquests of the race. Later on in the school course, when the pupil passes out of his elementary studies, which partake more of the nature of practice than of theory, he comes in the secondary school and the college to the study of science and the technic necessary for its preservation and communication. All these things belong to the first stage of school instruction whose aim is culture. On the other hand, post-graduate work and the work of professional schools have not the aim of culture as much as the aim of fitting the person for a social vocation. In the post-graduate work of universities the demand is for original investigation in special fields. In the professional school the student masters the elements of a particular practice, learning its theory and its art.

"It is in the first stage, the schools for culture, that these five coordinate branches should be represented in a symmetrical manner. It is not to be thought that a course of university study or that of a professional school should be symmetrical. But specializing should follow a course of study for culture in which the symmetrical whole of human learning and the symmetrical whole of the soul should be considered. From the primary school, therefore, on through the academic course of the college, there should be symmetry and five coordinate groups of studies represented at each part of the course—at least in each year, although perhaps not throughout each part of the year."

Discussing the second coordinate group, the biological, Doctor Harris argues that it should include "whatever is organic in nature—especially studies relating to the plant and the animal—the growth of material for food and clothing, and in a large measure for means of transportation and culture. This study of the organic phase of nature forms a great portion of the branch of study known as geography in the elementary school."

While it is probably true that eight years ago, when this was written, geography as taught in the primary grades of the best city schools included all the studies relating to the plant and the animal that were at that time considered necessary, it is also true that at the present time much of this study is introduced under the term "nature study," and the child's knowledge of the phenomena of plant and animal life is much clearer and more definite by reason of the concrete methods employed in nature study.

In the average village and rural school nothing approaching adequate instruction in the biological group of studies has ever been given. Geography, as far as taught in the primary grades, has consisted almost entirely of text-book work, and has had in it very little that is concrete or that touches the experience of the child. Nature study, on the other hand, begins with the concrete—with the organic life of the school yard, the garden, and the farm. It has, therefore, a very definite and useful place to fill among the culture studies, particularly the biological studies of the primary grades. Elementary nature study, together with an informal study of local geography, might well supersede the formal study of geography during the first three or four years. This should be followed by more formal geography and nature study, the latter to be superseded by the elements of agriculture when the child is eleven or twelve years old.

Agriculture should not be confused with manual training as taught in the city schools. Manual training "relates to the transformation of materials such as wood or stone or other minerals into structures for human use," and draws more from the mathematical group of studies than from the biological. Agriculture, on the other hand, is confined mainly to things biological. Its purpose in the common schools is to awaken an interest in the work and life of the farm, show the progress being made in the improvement of farming, indicate the rational and scientific basis of modern agriculture, and give the pupil an outlook toward the work of the experiment stations, agricultural schools and colleges, and other agencies for his future education or assistance in his life work.

The motive for teaching agriculture in the rural school may, however, to a considerable extent be the same as that for manual training in the city school—namely, to bring the child into direct and sympathetic relations with the industrial life of the community in which he lives. Undoubtedly, manual training in the city school has an outlook toward the shop, factory, and kitchen, and in the same way agriculture in the rural school should be directly related to the practical work of the farm.

A REASONABLE PROGRAMME FOR AGRICULTURAL TEACHING IN THE RURAL COMMON SCHOOLS.

Whenever it is proposed to introduce the teaching of agriculture into the rural common schools the objection is at once raised that the curriculum is already crowded; there is no time for more. This is true. There is no time for more, but there is time for better. It would be undesirable and unwise to do away with any of the studies now regularly taught in the common schools, but it would be wise to make a more judicious selection of the topics to be included in the courses in the various branches and omit much which now occupies the time of the pupils but which is not likely ever to be of use to them. Prof. Frank M. McMurray, of the Teachers' College of Columbia University, in a recent article discussing Advisable Omissions from the Elementary Curriculum, and the basis for them,[a] says, "Life is too full of large specific ends to be attained to allow time for work that has no really tangible object." As a basis for the rejection of subject-matter from school courses he holds to the following propositions:

"(1) Whatever can not be shown to have a plain relation to some real need of life, whether it be æsthetic, ethical, or utilitarian in the narrower sense, must be dropped.

"(2) Whatever is not reasonably within the child's comprehension, likewise.

"(3) Whatever is unlikely to appeal to his interest; unless it is positively demanded for the first very weighty reason.

"(4) Whatever topics and details are so isolated or irrelevant that they fail to be a part of any series or chain of ideas, and therefore fail to be necessary for the appreciation of any large point. This standard, however, not to apply to the three R's and spelling."

He does not favor the entire omission of any subject now taught in the elementary schools, but does recommend the omission of particular topics and details. Omission, however, is not the only remedy that he suggests for the crowded condition of the elementary school curriculum. In the last paragraph of this article he says:

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[a] Ed. Rev., 27 (1904), No. 5, p. 478.

"In conclusion, although some large topics should be omitted, reform in the main is not to be effected by lopping off here and there, but by changing the present aggregation of ideas in each study to an organized body of thought. It is not the task of grade teachers nor of scientists, but of the most advanced and ablest students of education, who are as well posted in subject-matter as in the principles of education itself. Even these have more than a life problem in such a task."

It is along lines such as these that the curriculum of the rural schools may be so far improved that there will be ample space for the teaching of agriculture in an effective way. Just as the courses in the city schools have been improved and enriched by the introduction of manual training, so the teaching of agriculture in the rural schools, when once parents and teachers are convinced of its importance and benefits, will be found to be both practicable and advantageous.

In a rural school having a curriculum extending over about eight years the courses in nature study might follow in a general way the brief outlines given below. In these outlines it is assumed that the nature-study courses will extend over about six years, and be followed by a course in agriculture extending over two years.

NATURE STUDY.

During the first two or three years in school the children should spend a short time each week in forming an acquaintance with the birds, insects, flowers, trees, and other animal and plant life of the school yard, the roadside, and the wayside pastures and wood lots. This very pleasant and profitable way of gaining knowledge has been their principal occupation during the two or three years that they have been running about out of doors at home, and they should be encouraged and aided to extend their knowledge of the things in nature with which they are likely to come in daily contact throughout their lives. The teacher should go with the children on short walks around the school yard and along the roads during occasional noon intermissions, or on longer trips in the fields and woods on Saturdays. It would be well if only a few children were taken at a time; ten or fifteen are all that one teacher can manage on such occasions. Each trip should be taken with some leading object in view, such, for example, as a search for cocoons, or for grasshoppers, or for weed seeds; but this leading object should not shut the eyes of the children to other things. Let them see and hear and feel and smell; let them grow in strength as well as in knowledge. Tell them very little; they should do the telling. Better wait days and weeks for an answer from the children than tell them now and rob them of the pleasure of discovery, provided the subject is within their comprehension.

Nature study at first should consist mainly of observations. The perceptive faculties should be stimulated and developed. For this reason the exercises should never be continued so long as to become wearisome to the children. At first there will seem to be but little connection between the different observations made by the children, but the teacher should never lose sight of the fact that very real and definite relationships exist between the different plants and animals of a given locality and between these things and their inorganic environment. Gradually, therefore, these relationships should be brought out. The children should describe and draw the objects seen. This will lead to comparison and judgment. Suppose, for example, that the children examine two trees of the same species, one growing in open ground with an abundance of plant food and plenty of room for development; the other growing in a dense forest with little room for either root or branch; one with short, stocky trunk and dense, symmetrical top; the other with tall, slender trunk and small, irregular top. By comparing certain well-known features of bark and leaves the children will readily recognize the two trees as belonging to the same species, but it will require considerable exercise of the reasoning faculties and pretty good judgment for them to get at the causes which have brought about the marked differences between them. Such opportunities to reason and judge are frequently offered in nature study, and the teacher should improve every opportunity to place them before her pupils.

After the first year or two, the time depending on the progress the children have made, more attention should be given to studying life histories of plants and animals (especially birds and insects), so that these may be recognized in all stages of their development, and their economic relations determined. This will enable the pupils to decide whether a given species is mainly beneficial or harmful and will set them to thinking about means of perpetuating or exterminating the species. This last consideration is the one which mainly determines the attitude of the farmer toward his field crops, domestic animals, and fowls, as well as toward the weeds and other pests that annoy him. When the nature-study teacher and her pupils have arrived at this point of view they will be in a position to pass over as unimportant such details as color of hair, length and number of teeth, number of leaves, length of petioles and internodes, and a hundred other peculiarities of plants and animals, except as these peculiarities have a direct bearing upon the perpetuation of the species or upon their usefulness or harmfulness to man. Such a point of view and such an attitude toward the things studied will aid greatly in developing in the children the faculty of critical discernment. This faculty, according to President Eliot, of Harvard, "ought to be carefully and incessantly cultivated by school, college, and the experience of life, for it is capable of contributing greatly to happiness as well as to material success."

Such critical studies of plants, animals, soils, weather conditions, and other natural objects and phenomena, in their relation to each other and to man, will give the pupils an excellent preparation to take up at the beginning of their sixth or seventh year in school the more formal study of the elements of agriculture.

ELEMENTARY AGRICULTURE.

The course in elementary agriculture may be given most appropriately during the last two years in the rural common school. The time to be devoted to this course will necessarily vary in different schools, but it is believed that on the average not less than one hour per week during two years will be required to make the course effective. A well-arranged and up-to-date text-book, with illustrations and suggestions for practical exercises, should be adopted as a basis for this study. A few such books already exist, and an increased demand would undoubtedly lead to the production of others and the still further improvement of books of this class. The text-book will in most cases be necessary as a more or less definite guide for the teacher, who will in all probability be without special training in agriculture. It will also be helpful to the pupils in giving a systematic view and in fixing definite knowledge of the subject, and to the parents in showing them what such instruction really involves and in creating an interest in the subject-matter of the books.

The instruction in the class room should be supplemented by simple experiments with soils, plants, and animals both at school and at home. Every effort should be made to connect the instruction with the home life of the pupils. As an aid to the accomplishment of this aim the pupils should be taken on occasional Saturday excursions to neighboring farms to see improved live stock, examine plans of buildings, and take notes on methods of cropping and cultivating. Visits to county fairs, where arrangements could be made to allow the older pupils to judge some of the live stock, fruits, and grain, and compare their scores with the work of the judges, would be fine training for the classes in agriculture. This scheme has been tried with older students of agriculture and has met with thorough approval. The officers of the fairs could probably be induced to offer prizes for products grown by the pupils and for other agricultural work done by them; or special exhibits of their work could be made at farmers' institutes or other meetings attended by their parents. All these things would tend to create an interest in farm life, and would encourage parents to make the farm more attractive to the children.

The schoolrooms should be provided with illustrative material consisting of charts, pictures, collections of specimens (largely made by the pupils), and boxes, cans, plates, and other inexpensive material which can be used in making apparatus for conducting experiments. There should also be a school library containing at least a few standard reference books on the different divisions of agriculture and the publications of the State experiment stations and the United States Department of Agriculture.

The text-book of agriculture should give an orderly and progressive treatment of the elements of plant production, animal production, and dairying, together with brief and very elementary discussions of a few topics in rural engineering and rural economics. The following syllabus shows in a general way what such a text-book might include:

SYLLABUS OF ELEMENTARY COURSE IN AGRICULTURE.[a]

I. PLANT PRODUCTION.

- (1) The plant
  - Structure.
  - Physiology—how plants
    - Feed.
    - Grow.
    - Reproduce by
      - Seeds — Trace life history from seed to seed, noting pollination, crosses, hybrids, etc.
      - Bulbs.
      - Cuttings.
      - Grafts.
      - Buds.
- (2) The environment of the plant.
  - Climate
    - Light.
    - Heat.
    - Moisture.
    - Air.
    - Study these in relation to plant growth.
  - Soil
    - Nature and functions.
    - Origin.
    - Properties — Distinguish between light and heavy soils, porous and impervious soils, soils that bake and those which do not, etc.
    - Classification. — Main classes, such as sand, clay, loam, peat, silt.
    - Temperature.
    - Aeration.
    - Moisture.
    - Management.
      - Tillage.
      - Drainage.
      - Irrigation.
      - Enrichment.
        - Farm manures.
        - Commercial fertilizers.
      - Impoverishment.
      - Cropping—rotation.

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[a] In this syllabus the same general arrangement of topics has been made as in the higher courses outlined by this committee, but it is of course to be understood that the treatment of these topics by the teacher in the common school should be brief, simple, and elementary.

- (3) Farm crops.
  - Classification
    - Include only the most general classes, such as cereals, grasses, legumes, tubers, etc.
  - Individual crops. (Study one or more of the leading crops of the region.)
    - Name.
    - Place in classification.
    - Varieties.
    - Culture
      - Preparation of soil.
      - Selection of seed.
      - Testing of seed.
      - Planting.
      - Cultivating.
      - Protection from pests.
        - Weeds.
        - Diseases.
        - Insects.
        - Birds.
        - Mammals.
      - Harvesting.
      - Marketing.
- (4) Fruits
  - One or more of the leading fruits of the region should be studied in the same manner as farm crops.

II. ANIMAL PRODUCTION.

- (1) Domestic animals—their types and breeds.
  - Horses
    - Draft.
    - Trotting.
    - Roadsters, etc.
  - Cattle
    - Dairy.
    - Beef.
  - Sheep
    - Wool.
    - Mutton.
  - Swine.
  - Poultry.
  - Bees.
  - Bring out leading characteristics of one or two leading breeds of each type represented in a given region.
- (2) Care and management of domestic animals.
  - Feeding
    - Only the most general statements regarding the food requirements of different animals and for different purposes, and exercises in compounding rations suitable to a given region.
  - Hygiene
    - Water supply.
    - Exercise.
    - Shade.
    - Condition of inclosures as to
      - Comfort.
      - Ventilation.
      - Cleanliness.
  - Preparation and care of product.
  - Marketing product.

III. DAIRYING.

- (1) The dairy cow
  - Type
    - A more detailed study of the dairy type than was given under animal production.
  - Feeding, care, and management.

(2) MILK
- Composition
  - How determined.
  - Relation to price.
- Handling
  - Cleanliness
    - Stables.
    - Cows.
    - Attendants.
    - Vessels.
  - Straining.
  - Aerating.
  - Cooling.
    - Relation to souring [or tainting] of milk.
- Uses
  - For consumption as milk or cream.
    - Putting up in cans or bottles.
    - Marketing.
  - For condensing.
    - Putting in cans and hauling.
  - For cheese making.
  - For butter making.
    - Creaming
      - By setting in pans.
      - By use of separator.
    - Churning
      - Temperature.
      - Kinds of churns.
    - Salting.
    - Coloring.
    - Working.
    - Packing.
    - Marketing.

IV. RURAL ENGINEERING.

It is not thought that the pupils in a rural common school will be prepared to study the problems involved in rural engineering from the view point of the engineer, but it is hoped that there will be some opportunity to examine the plans and structure of good types of buildings, fences, roads, etc., and to devote some time to drawing simple plans of farms, buildings, and other works. The importance of good roads, hygienic water supply and sewage disposal, and of caring for farm machinery should be emphasized.

(1) FARM PLANS
- Size and location of fields.
- Location of buildings, fences, drains, and roads.

(2) CONSTRUCTION OF BUILDINGS AND WORKS.
- Buildings
  - House.
  - Barn.
  - Outbuildings.
  - Fences.
- Water system.
- Sewage system.
- Roads.
- Irrigating system
  - Only in regions where irrigation is practiced.

(3) FARM MACHINERY
- Interesting facts regarding the development of farm machinery in a way to encourage the more general use of improved machinery.
- The importance of caring for and repairing farm machinery.

V. RURAL ECONOMICS.

Most of the topics under rural economics are too broad to be included in a brief course in agriculture, or too complex fr the comprehension of common school pupils. It is thought, however, that some of the general principles of marketing and farm accounts might be taught in this connection. The main factors in marketing will probably be best considered in connection with the disposal of particular products as indicated above under plant production, animal production, and dairying. The following topics are appropriate for this course:

(1) MARKETING
- Preparation for market.
- Choice of market.
- Transportation.
- Method and cost of sale.

(2) FARM ACCOUNTS
- Feed and milk records.
- Crop records.
- Breeding records.
- Inventories.
- Bookkeeping.

This to include only the most general suggestions and a discussion of the importance of keeping full and accurate records.

A. C. TRUE,
H. H. WING,
T. F. HUNT,
H. T. FRENCH,
J. F. DUGGAR,
Committee.

The report was accepted.

THE SOCIAL PHASE OF AGRICULTURAL EDUCATION.

A paper on this subject was presented by K. L. Butterfield, of Rhode Island, as follows:

I have been asked to speak in behalf of the study of "rural economics." This term is, I presume, supposed to cover broadly those subjects which treat of the economic and social questions that concern farming and farmers. The whole range of social science as applied to rural conditions is thus apparently made legitimate territory for discussion. In view of the importance and character of this field of study, it seems wise to approach it, if possible, through the avenue of its underlying philosophy. Only in this way can the validity of the subject be established and its place in agricultural education be justified. I have therefore chosen as a specific title "The Social Phase of Agricultural Education." In the treatment of the topic an endeavor has been made to hold consistently in mind the point of view of the agricultural college.

It is a principle in social science that the method and scope of any social institution depend upon its function. Therefore the organization, the methods, and the courses of the agricultural college should be made with reference to the function of the college. What is this function? What is the college designed to accomplish? What is its social purpose? Why does society need the agricultural college? Answers to these questions are of two kinds—those that explain the contemporary and passing functions of the college, and those that illustrate its permanent and abiding service to society and particularly to the rural portion of society. The college of yesterday was obliged to train its own teachers and experimenters; to-day it may add the task of training farm superintendents; to-morrow it may organize an adequate extension department. Courses and methods will change as new contemporary needs arise, but there remains always the abiding final service of the agricultural college—its permanent function. This function will be defined in different ways by different men, but I venture to define it as follows: The permanent function of the agricultural college is to serve as a social organ or agency of first importance in helping to solve all phases of the rural problem. We shall not attempt at once to argue this proposition. We must, however, try to answer the question, What is the rural problem? And in the answer may be revealed, without need of extended discussion, the mission of the college.

(1) The days are going by when agriculture may be classed with the mining industries. Soil culture is supplanting pioneer farming. Skill is taking the

place of empiricism. The despotism of the grandfather is passing. Applied science and business practice have been hitched to the plow. Yet the most obvious need of American agriculture is better farming. Improved farm land in the United States gives but $9 of gross return per acre. The average yield per acre of corn is 23.5 bushels, whereas a very modest ideal would be double this amount. The wheat yield is 13.5 bushels per acre; in Germany nearly twice as much. These are crude, but legitimate, illustrations of our inferior farming. We must have greater yields of better products, secured at less cost per unit. The farm problem is therefore first of all a problem of increasing the technical skill of our farmers. Science unlocks the cabinet of Nature's treasures, but only the artist farmer can appreciate and use the storehouse thus opened to him.

(2) But produce growing is not the only aspect of the farm problem. Each effective pair of shears needs two blades; in this case produce selling is the other blade. Mere productiveness does not solve the farm question. The farmer cares less for the second spear of grass than he does for a proper return from the first spear. Business skill must be added to better farming methods. The farm problem is also a business question.

(3) The moment, however, we begin to discuss price we enter a realm where economic factors dominate. We commonly say demand and supply determine price; but effective demand and effective supply are the resultants of many forces. The supply of a given product is influenced by the cost of growing in various locations, by cost of transportation, by competition of other countries. The demand is influenced by the state of wages, by standards of living, by effectiveness of distribution. The farmer may not always control these conditions, but he must reckon with them. He must know the laws of economics as well as the laws of soil fertility. The farm problem becomes then an industrial question, for the farmer's prosperity is influenced most profoundly by the economic life of the nation and of the world. And in a still wider sense is the rural question one of economics. The industry as a whole must prosper. It is of no great moment that here and there a farmer succeeds. The farming class must prosper. Of course individual success in the case of a sufficient number of farmers implies the success of the industry, but it is quite possible to have a stagnant industry alongside numerous individual successes. The farmers as a whole must be continually and speedily advancing to better economic conditions.

(4) Nor may we ignore the political factor in the rural problem. Doubtless the American farmer, like most Americans, places undue reliance upon legislation. But we can not disregard the profound industrial and social effects of either wise or foolish laws. The political efficiency of the farmer will have much to do in determining class progress. Furthermore, the political duties of farmers must be enforced, their influence must continue to be exerted in behalf of the general policies of government. It is of vital consequence to our democratic government that the American farmer shall in nowise lose his political instinct and effectiveness.

(5) The consideration of the political phase of the question leads us to the heart of the farm problem. For it is conceivable that the farmers of this country may as a class be skilled growers of produce, successful sellers of what they grow, and indeed that the industry as a whole may be prosperous, and yet the farming class in its general social and intellectual power fail to keep pace with other classes. It is not impossible that a landlord-and-tenant system, or even a peasant system, should yield fairly satisfactory industrial conditions. But who for a moment would expect either system to develop the political and general social efficiency that American democratic ideals demand? Even if there is no immediate danger of either of these systems becoming established in America, we still desire that our farmers as a class shall secure for themselves the highest possible position not only in industry but in the political and social organization of American society. Indeed this is the ultimate American rural problem, to maintain the best possible status of the farming class. No other statement of the problem is satisfactory in theory. No other is explanatory of the struggles and ambitions of farmers themselves. The American farmer will be satisfied with nothing less than securing for his class the highest possible class efficiency and largest class influence, industrially, politically, socially. It is true that industrial success is necessary to political and social power, but it is also true that social agencies are needed in order to develop in our American farmers the requisite technical skill, business method, and industrial efficiency. The influence of such social forces as education, developed means of communication, the organi-

zation of farmers, and even the church, must be invoked before we can expect the best agricultural advancement. And the end is after all a social one. The maintenance of class status is that end.

This analysis of the rural problem is necessarily brief, almost crude, but I hope that it reveals in some degree the scope and nature of the problem; that it indicates that the farm question is not one merely of technique, fundamental as technical skill must be; that it demonstrates that the problem is also one of profound economic, political, and social significance. If this be so, do we need to argue the proposition that the function of the agricultural college is to help solve all phases of the problem? We all recognize the place of the college in assisting our farmers to greater technical skill. By what pleas shall we gainsay the mission of the college in ministering to rural betterment at all points, whether the conditions demand technical skill, business acumen, industrial prosperity, political power, or general social elevation? Why shall not the agricultural college be all things to all farmers?

Assuming that this statement of the permanent mission of the agricultural college is an acceptable one, the practical inquiry arises, Does the college, as now organized, adequately fulfill its function, and, if not, by what means can the defect be remedied? The colleges are doubtless serving the industrial and social need to some degree. But I believe that it is not unjust to assert that the existing courses of study in agriculture, the organization of the college, and the methods of work are not adequate if the college is to secure and maintain this supreme leadership all along the line of rural endeavor. This is not criticism of existing methods. The colleges are doing good work. But the present effort is partial, because the emphasis is placed upon the technical, and especially upon the individual, phases of the problem. The industrial, the political, and the social factors are not given due consideration. Our present-day agricultural course, on the vocational side, is chiefly concerned with teaching the future individual farmer how to apply the principles of science to the art of farming, and in training specialists who shall make further discoveries either in the realm of science or in the application of the scientific principle to the art. The technical element absolutely dominates the vocational portion of the agricultural course. Very slight attention is given to the discussion of other phases of the farm problem. To meet the needs of the future the whole spirit and method of the agricultural college must be "socialized"—to use an overworked phrase for want of a better one. We must get away from the idea that the individual and the technical aspects of agricultural research and teaching are the sufficient solution of the farm problem.

When we ask, What are the means for "socializing" the agricultural college? the expected answer may be, The study of rural social science, or "rural economy." But I am pleading not merely for the addition of a few subjects to the course of study, but for an educational policy. The answer, therefore, will not be quite so simple. What, then, are the methods by which the college may more fully assume its function of helping to solve all phases of the farm problem?

(1) The indispensable requirement is that the college shall consciously purpose to stand as sponsor for the whole rural problem. It is to assume a place of leadership in the campaign for rural betterment. Whether or not it is to be the commander in chief of the armies of rural progress, it should be the inspiration, the guide, the stimulator of all possible endeavors to improve farm and farmer. This attitude of mind is purely a matter of ideals, deliberately formed in the light of the abiding needs of the farming class. It is the intangible but pervasive influence of an object which is perfectly definite even if avowedly spiritual. It is a question of atmosphere. It is a matter of insight. The college must have a vision of the rural problem in its entirety and in its relations. At the college we should find, if anywhere, the capacity to understand the ultimate question in agriculture. We know that this ultimate question in agriculture can not be expressed alone by the terms nitrogen, or balanced ration, or cost per bushel, but must be written also in terms of the human problem, the problem of the men and women of the farm. So we shall see the college consciously endeavoring to make of itself a center where these men and women of the farm shall find light and inspiration and guidance in all the aspects of their struggle for a better livelihood and a broader life. The college must avow its intention of becoming all things to all farmers. Whether this means the study of fertility, of animal nutrition, of soil bacteriology, or whether it means the consideration of markets, of land laws, of transportation, of the country church, of pure government, the college will lead the way to the truth.

(2) As the first requisite is that of the conscious ideal or purpose, the second is one of organization. It seems to me that the socialization of the college can not proceed very far until the principle of university extension is pretty fully recognized. The college must be in constant and vital touch with the farmers and their associations. Therefore each agricultural college should as rapidly as possible develop a definite tripartite organization which reveals the college in its threefold function as an organ of research, as an educator of students, and as a distributor of information to those who can not come to the college. These are really coordinate functions and should be so recognized. The college should unify them into one comprehensive scheme. The principle of such unity is perfectly clear; for we have in research the quest for truth, in the education of students the incarnation of truth, and in extension work the democratization of truth. Until these three lines of effort are somewhat definitely recognized and organized the college can not work as leader in solving the rural problem.

(3) The social sciences, in their relation to the rural problem particularly, must receive a consideration commensurate with the importance of the industrial, the political, and the social phases of the farm question. In research, for instance, the colleges should make a study of the history and status of these aspects of agriculture. As a matter of fact, we know very little of these things. There have been but few scientific investigations of the economic features of the industry, and practically nothing has been done in the more purely social questions. Here is a great untilled field. How the various farm industries have developed, a comprehensive study of the agricultural market, the relation of transportation to the industry, the tendencies as to centralization of farms and tenant farming; the sociological questions of rural illiteracy, pauperism, insanity, health, education, the effects of rural life upon character, religious life in the country—a hundred subjects of importance in the solution of the farm problem are almost virgin soil for the scientific investigator. It is the business of the agricultural colleges to assist, if not to lead, in such work of research. It is work that must be done before the social phases of agricultural education can be fully developed.

When we come to the course of study we face a question difficult for some colleges, because the agricultural curriculum is already overcrowded. I have not time to discuss this practical administrative question. I believe, however, that it can be worked out. What I wish to emphasize is the idea that in every agricultural course the social problems of the farmers shall have due attention. We should not permit a person to graduate in such a course unless he has made a fairly adequate study of the history and status of agriculture; of the governmental problems that have special bearing upon agricultural progress; of such questions in agricultural economics as markets, transportation, business cooperation, and of such phases of rural sociology as farmers' organizations, the country church, rural and agricultural education, and the conditions and movements of the rural population. For the college can not carry out the purpose we have ascribed to it, unless these subjects are given an important place in the course of study. We talk about the work of the college in training leaders, usually meaning by leaders men who are expert specialists or possibly farmers of extraordinary skill. Do we realize that the greatest need of American agriculture to-day is its need of social leadership? Nothing can be more imperative than that the agricultural college shall send out to the farms both men and women who have not only the capacity to win business success, but who also have the social vision, who are moved to be of service to the farm community, and who have the training which will enable them to take intelligent leadership in institute, school, church, grange, and in all movements for rural progress. Upon the college is thrust the responsibility of training men and women to understand the whole rural problem and from the vantage ground of successful farming to be able to lead the way toward a higher status for all farmers.

Possibly the argument for introducing rural social science into the agricultural course is chiefly a sociological one. But there is also involved a pedagogical question of most profound significance. For several decades the educational camp has been sharply divided over the ancient but recurring controversy between the Greek cultural ideal and the Roman utilitarian ideal. I venture the opinion that these two forces of educational idealism will soon reach a compromise which for all practical purposes will take this question out of the pale of serious debate. The classicist will concede that the scope of the term culture may be greatly enlarged and he may even allow a quite new definition of the cultivated man. It will be generally admitted, to use Professor

Bailey's phrase, that "every subject in which men are interested can be put into pedagogic form and be a means of training the mind." On the other hand the technical educator will concede that a college graduate in whatever course should be a cultivated man and that there are certain studies with which all cultivated men should have some familiarity. The technical college will, moreover, be compelled to employ instructors who can so teach the technical subject that it shall not only give the knowledge and training desired, but shall also yield sound culture, become truly liberalizing and vision giving. But a greater question remains. As society becomes more fully self-directive the demand for social leadership increases. Almost instinctively we look to the college-trained man for such leadership. We expect him to understand and to help answer the questions that society has to meet. It is not enough that he do his particular work well; he has a public duty. Only thus can he pay all his debt to society for the training he has had. Yet to-day our technical courses are largely engaged in training individuals who, barring some general culture, are highly specialized experts. What preparation, for instance, does the future engineer get in college for facing such a matter as the labor question? He is likely to be brought into close touch with this question. But as a rule he is not especially qualified to handle it. The point of view of the course he has pursued is technique, ever technique. He secures in college little incentive and less training for intelligent performance of his duty as citizen and as member of society. The problems of mathematics are not the problems of industry, and profound study of chemistry gives neither the premises nor the data for sound judgment upon social questions. These public questions can not be left to social experts. A democratic society must insist that all its educated men shall be leaders in solving society's problems. But even the educated men can not lead unless they have first been taught. I believe society has more to fear from technical experts who either neglect their social duty or are ignorant of the social problem than it has from highly trained specialists who have never studied Greek nor mastered Browning. Moreover, under modern conditions, have we a right to call that man cultivated who ignores the great social problems of the age? We face here one of the coming educational questions, How can the industrial course be made to train men for the social leadership the new régime demands? I see no answer except that the course must be made truly and broadly vocational, and consequently that large place must be given to social studies, and particularly to the concrete problems of government, industry, and social life.

If we examine our agricultural course from this standpoint, we shall have to admit that it has the flaw common to most industrial courses. It is too technical. It is not truly vocational. It does not present the social view point. It does not stimulate the student to social activity. It does not give him a foundation for intelligent social service when he shall go to the farm. He should study agricultural economics and rural sociology, both because rural society needs leaders and because, in the arming of the man, the knowledge of society's problems is just as vital as either expert information or personal culture.

(4) To carry out the function of the agricultural college we need, finally, a vast enlargement of extension work among farmers. This work will not only be dignified by a standing in the college coordinate with research and the teaching of students, but it will rank as a distinct department, with a faculty of men whose chief business is to teach the people who can not come to the college. This department should manage farmers' institutes, carry on cooperative experiments, give demonstrations in new methods, conduct courses of reading, offer series of extension lectures, assist the schools in developing agricultural instruction, direct the work of rural young people's clubs, edit and distribute such compilations of practical information as now appear under the guise of experiment-station bulletins, and eventually relieve the station of the bulk of its correspondence. Such a department will be prepared to incorporate into its work the economic, governmental, and social problems of agriculture. It will give the farmers light upon taxation as well as upon tree pruning. The rural school will have as much attention as corn breeding. The subject of the market—the "distributive half of farming," as John M. Stahl calls it—will be given as much discussion as the subjects bearing upon production. We shall find here a most fertile field for work. The farmers are ready for this step. They have, as a rule, appreciated the real nature of the farm problem more fully than have our agricultural educators. Perhaps at times they have placed undue reliance upon legislation. Perhaps in periods of depression they have overweighed the economic pressure as against the lack of skilled farming. But

the great body of farmers has rightly estimated the importance of the economic, political, and social questions as related to their ultimate prosperity. In grange meetings, for example, the subjects which arouse greatest interest are such themes as taxation, the rural telephone, the country school, and business cooperation. The explanation of all the farmers' movements is that the farmers believe the farm problem to be much more than a question of technique. They want light on the whole problem.

The college, chiefly through its socialized extension department, has a mission also to those professional people whose sphere of work is in the rural community. The rural educator, the country clergyman, the editor of the country paper, and even the lawyer and physician who deal with country people should have a large share in helping to solve the farm problem. They, too, need to know what the rural problem is. They, too, need the eye that sees the necessary conditions of rural betterment and the heart that desires to help in rural progress. By some of the same methods that reach the farmers themselves can the college instruct and inspire these others.

And, finally, the college will take its place as the "social organ or agency of first importance in helping to solve the farm problem in all its phases." The church, the school, the farmers' organization—all these social organs have their work to do. None can do the work of the others. But they should work together. Each should appreciate its own mission and its own limitations; each should recognize the function of the others, and all should intelligently unite their forces in a grand campaign for rural betterment. More properly than perhaps any other agency the socialized extension department of the agricultural college can act as mediator and unifier, serve as the clearing house and directing spirit in a genuine federation of rural social forces. Inspired by the conscious purpose of the college to help at all points in the solution of the farm question, informed by the knowledge acquired through research into the economic and social problems of agriculture, aided by a multitude of educated farmers trained in the colleges to know the rural problem and to lend a hand in its settlement, dignified by its status as a coordinate branch of the college activities, the extension department may well act as the chief agency of stimulation and unification in the social movements for rural advancement.

In this discussion the practical details of carrying out the programme advocated have not been touched upon. When once it becomes a distinct policy of the college to assume leadership in the movement for rural betterment, such questions as subject-matter for study, text-books, qualified instructors, and time in the curriculum will settle themselves. Neither has any attempt been made to give illustrations; and therefore this paper may seem dogmatic if not academic, a prophecy rather than an outline of progress, the statement of an ideal rather than a practicable programme. But I think there is abundant evidence that a current is setting in toward the enlargement of the work of the agricultural college along the social lines indicated. The rapid development of farmers' institutes, the growth of other phases of extension teaching, the sentiment of those in authority that the experiment station must soon slough off its work of education and confine itself to research, the holding of occasional conferences for rural progress, in which country teachers and pastors join with the farmers, the initiative of the college in federating various State farmers' organizations into one grand committee, the inauguration of several brief courses in agricultural economics and rural sociology, the cooperation of some of the colleges with the Carnegie Institution in an investigation into the history and conditions of agriculture in its economic and social phases, the pride with which a few of our colleges point to the increasing number of young men they are sending to the farms—all these facts seem clearly to indicate that the agricultural college will soon assert its function of leader in the endeavor to solve all phases of the rural problem.

If the analysis thus far offered is a correct one, the question of "rural economics" is far from being merely a matter of adding three or four subjects of study to the agricultural course. It involves the very function and policy of the college itself. It alone gives proportion to the problem of agricultural education, because, while distinctly admitting the need of better farming and the consequently fundamental necessity of the technical training of farmers, it emphasizes the importance of the economic and political and social aspects of rural development. And it thereby indicates that only by a due recognition of these factors, in purpose, in organization, and in course of study, can the American agricultural college fulfill its mission to the American farmer.

COOPERATION BETWEEN THE STATIONS AND THE U. S. DEPARTMENT OF AGRICULTURE.

This being the special order for the hour, E. A. Bryan, chairman of the committee of the association on cooperation, submitted the following report:

Your committee on cooperation between the stations and the U. S. Department of Agriculture would respectfully report that satisfactory progress has been made so far as the details of the arrangement of any cooperative work undertaken by the stations with the Department of Agriculture are concerned. Questions, however, of the most fundamental importance, involving the relations of the two institutions, having arisen, the executive committee of this association, on the invitation of the Secretary of Agriculture, held certain conferences with the Secretary, a report of which has already been made to you. It therefore seemed expedient to your committee, pending the period during which the executive committee was dealing directly with the problem, to submit no further recommendations in the premises. There will doubtless continue many questions for adjustment which will require the services of a standing committee, there being a similar committee appointed by the Secretary of Agriculture for that purpose.

E. A. BRYAN, *Chairman.*

E. A. BRYAN. It has been evident, I think, to all members of this association that for some years a number of questions have arisen between the experiment stations and the Department of Agriculture which would require adjustment. It was perhaps with a view to these questions that a few years ago a committee on cooperative work was appointed by this association, which from year to year has made reports. These reports were usually brief and related mainly to certain details of the contracts which might be made between the experiment stations and the Department of Agriculture relative to any given piece of cooperative work which might be undertaken by them. As this report indicates, very satisfactory progress has been made in that direction, but it has not been so apparent that the whole matter is settled by the arrangement of these small details. In fact, it has become more and more apparent that there are still more fundamental questions that remain unsettled, and while the policy of the committee thus far has been rather to avoid than to court much discussion in this body, yet the time seems to be ripe for a full and free discussion of the whole question involved.

The report was accepted.

A lively discussion, conducted with frankness but good feeling, followed, in which it was maintained that a clearer definition of the respective functions and limitations of the Department and the experiment stations was essential to more effective cooperation, and that the complete autonomy and independence of the stations in administrative and in scientific work, but with increased funds, would tend to make them more effective cooperating agents. Full confidence was expressed that a way would be found to prevent any apparent antagonism or duplication.

The following resolution, introduced by W. H. Jordan on behalf of the executive committee, was adopted after debate:

Resolved, That this association emphatically recognizes the great services which the National Department of Agriculture is now rendering to the science and practice of agriculture, and to the institutions here represented, by its helpful cooperation with the agricultural experiment stations and by its able coordination and wide dissemination of the information secured within itself and by the experiment stations; and this association views with disfavor any movements which, either by legislation or otherwise, shall tend to disturb or lessen the mutually advantageous relations which now exist between the Department of Agriculture and the experiment stations of the several States.

Resolved, That this association is firmly of the opinion that the continuation and development of these mutually helpful relations between the Department and the stations and the maintenance and progress of efficient research in agricultural science demand that the autonomy and paramount position of the stations as institutions of research and experimentation be inviolably maintained within their respective States, in accordance with the terms and spirit of the Hatch Act.

Resolved, That in order that Congress may be properly informed as to the work of the agricultural experiment stations and its great value to agricultural practice, and to promote satisfactory relations between the Department of Agriculture and the experiment stations, the executive committee of this association is hereby instructed to request a hearing before the proper committees of Congress for the purpose of presenting the work and claims of the agricultural experiment stations, and to continue conferences with the honorable Secretary of Agriculture relative to cooperation between his Department and the stations.

GRADUATE STUDY.

L. H. Bailey, of New York, reported for the committee on this subject, as follows:

The committee on graduate work has had two meetings here to discuss the question of the graduate school of agriculture, such a school as was held two or three years ago at the Ohio State University. The whole question has been discussed as to whether it was good policy to continue such a school; and if so, under what conditions. It has seemed to the committee that it is desirable to continue the school under the auspices of this association. It has seemed also that those who conduct these schools should not bear the whole expense. It is suggested, therefore, that some means be provided whereby the different colleges in the country should be requested to contribute a small sum each year to aid in the maintenance of these graduate schools of agriculture. This can be justified from the point of view that this graduate school of agriculture, held every two or three years, as the case may be, affords an opportunity for each contributing college to give its men opportunity for advanced work which they do not have in any other way. It would seem, therefore, that it would be a good policy for the institutions to help to maintain a graduate school, in order that their men may have an opportunity to come in contact with other men. The second part of the attitude of the committee is, I think, equally important—that is, that there should be some place in the country where our workers meet other workers. This association has come more and more to be a delegate association. Every one of us would like to have our chemists meet other chemists, and so with the botanists, horticulturists, and other scientists. The committee therefore recommends the following:

(1) That this association reaffirm its conviction that a graduate school of agriculture is a desirable enterprise to be conducted in the summer at different colleges of agriculture in rotation.

(2) That this school be held every two years, beginning, if possible, with this coming summer.

(3) That each agricultural college be requested to contribute a small sum annually—say $25—to aid in the maintenance of such school.

(4) That the committee on graduate study be empowered to determine where such schools shall be held.

(5) That it is the judgment of this association, while not desiring to limit the expenditures to any specified sum, that such schools of agriculture be conducted with the least possible expense consistent with the character of the work.

The report was adopted.

It was suggested that the committee prepare a circular of information regarding the school, to be sent to the different institutions interested.

MILITARY INSTRUCTION.

C. R. Van Hise, of Wisconsin, offered the following:

The chief purposes of the agricultural and mechanical colleges are indicated by their name. It is the clear intent of the Morrill Act that military work be subordinate to these purposes: Therefore, be it

Resolved by the Association of American Agricultural Colleges and Experiment Stations, that it is unwise to require military drill from each student more than two times per week during two years; and

Resolved, That the executive committee be instructed to present the views of the association in reference to Order 65 to the Secretary of War, or if it seems preferable to the executive committee, that they be authorized to appoint a special committee for this purpose.

The resolution was referred to the section on college work and administration (see p. 91).

RESOLUTION REGARDING HON. H. C. ADAMS.

W. A. Henry, of Wisconsin, introduced the following resolution:

Resolved, That the Association of American Agricultural Colleges and Experiment Stations, in convention assembled, tender to the Hon. H. C. Adams, of Madison, Wis., its hearty thanks for his earnest, intelligent, and well-directed efforts in the last session of Congress to secure increased support for and to strengthen agricultural research in the various experiment stations of this country.

Resolved, That we hereby pledge him our hearty cooperation and assistance in his continued efforts to this end.

Resolved, That the secretary be instructed to send a copy of these resolutions by telegraph and this be followed by a copy transmitted by mail, and that a copy of these resolutions be entered in the records of this association.

Referred to the executive committee, reported favorably, and adopted.

EXTENSION OF FRANKING PRIVILEGE.

E. Davenport, of Illinois, offered the following resolution:

Resolved, That it is the sense of this association that engineering experiment stations established in connection with land-grant colleges should enjoy the franking privilege for their publications as well as do the agricultural experiment stations for theirs.

Resolved further, That the executive committee be instructed to institute measures calculated to secure this privilege.

A similar resolution regarding publications of extension work departments of land-grant colleges was introduced by K. L. Butterfield, of Rhode Island. Both resolutions were referred to the executive committee, reported without recommendation, and after debate withdrawn by the movers.

On motion, the association adjourned to meet at 8 o'clock p. m.

EVENING SESSION, WEDNESDAY, NOVEMBER 2, 1904.

The convention was called to order by the president, W. O. Thompson.

H. C. WHITE. The executive committee is informed and hereby announces that the section on college work and administration has given its assent to the resolutions passed this morning concerning the relations of the Department of Agriculture to the experiment stations (see p. 62), and also to the resolution offered by Director Armsby directing the executive committee to continue its efforts in relation to the experiment station bill and the mining school bill (see p. 43).

RESOLUTION REGARDING HON. F. W. MONDELL.

J. K. Patterson, of Kentucky, offered the following resolution, which was reported favorably by the executive committee and adopted:

Resolved, That the Association of American Agricultural Colleges and Experiment Stations, in convention assembled, extends to Hon. Frank W. Mondell, of Wyoming, its hearty thanks for his able, wise, and energetic efforts in connection with his bill pending for the establishment and maintenance of schools or departments of mines and mining in connection with the land-grant colleges and other institutions, introduced by him and now pending in the Fifty-eighth Congress. This association is sincerely appreciative of the great service in the cause of industrial education thus rendered by Mr. Mondell, and pledges him its cordial support and assistance in his continued efforts in this direction.

Resolved, That these resolutions be entered on the records of this meeting and a copy be transmitted immediately to Mr. Mondell.

RESOLUTION REGARDING MAJ. HENRY E. ALVORD.

For the committee on resolutions concerning the late Henry E. Alvord, J. K. Patterson, the chairman, presented the following:

This association has heard with profound regret of the death of Maj. Henry E. Alvord. He had not reached the average limit of human life, and many years of usefulness seemed yet to lie before him when the end suddenly came. But within the limits of the life allotted to him he had accomplished more than many of his contemporaries.

Sprung from a hardy New England stock, endowed with a vigorous physical constitution and an active mind, his education was liberal as well as practical, and his opportunities were well improved. Leaving the employment of a civil engineer, in which he doubtless would have earned distinction, he offered his services ere he had attained his majority to the Government at the beginning of the civil war, entering as a private at its commencement, and advancing to the rank of major before its close. Promoted into the Regular Army because of the effective service which he had rendered as an officer of volunteers, he served in that branch of the service until 1872, resigning with the rank of captain.

As special Indian commissioner, as manager of the Houghton farm, as secretary of the American Jersey Cattle Club, as professor of agriculture in the Massachusetts Agricultural College and in New Hampshire College of Agriculture and Mechanic Arts, as president of the Agricultural College of Maryland, as president of the Oklahoma Agricultural and Mechanical College, as president of this association, and as chief of the Dairy Division in the Department of Agriculture, he identified himself with the progress of scientific agriculture in America to a degree above and beyond most men of his time.

But it is as one of the founders and one of the members of this association that we knew him so intimately and so long. To his remarkable power of initiative, his happy appreciation of opportunities, and his singular forecast of the possibilities of an organization such as this, its origin and success are largely due. His intimate relations with members of Congress and his acquaintance with legislative procedure in committee and on the floors of the Senate and House were of incalculable value in its inception and in its growth. The impress of his masterly hand remains upon this association to this day. During the progress of the Hatch Act through Congress in 1887 and of the Morrill bill in 1890, his activity was indefatigable.

This association therefore desires to place on record its high estimate of his ability, his integrity, his knowledge of men, his great powers of organization, his singular fidelity to his cherished ideals, his intelligent directive powers, his great common sense, and his uniform courage and courtesy in maintaining his views of public policy.

A sincere friend, a patriot, a soldier without sectional bitterness or prejudice, an efficient administrative, and a wise counselor, with a lofty ideal of duty and of honor, this association discharges a duty to itself by bearing hearty testimony to his conspicuous worth as a citizen and as a man.

Resolved, That a copy of this paper be incorporated in the record of this association, and a copy be sent by the secretary with assurance of sympathy and condolence to the family of the deceased.

JAMES K. PATTERSON,
H. P. ARMSBY,
W. A. HENRY,
Committee.

On motion of President W. E. Stone, of Indiana, seconded by President J. C. Hardy, of Mississippi, the resolutions were unanimously adopted by rising vote.

ELECTION OF OFFICERS.

M. A. Scovell, of Kentucky, reported that the section on experiment station work nominated to the convention for chairman of that section H. J. Patterson, of Maryland, and for secretary M. A. Scovell, of Kentucky.

W. E. Stone reported for the section on college work and administration that that section nominated as chairman R. W. Stimson, of Connecticut, and as secretary K. L. Butterfield, of Rhode Island.

On motion, these reports were adopted.

Mr. Scovell reported as members of the executive committee named by the section on experiment station work W. H. Jordan, of New York, and C. F. Curtiss, of Iowa, and as members of the programme committee M. A. Scovell, J. F. Duggar, and C. D. Woods.

Mr. Stone reported as members of the executive committee from the section on college work and administration H. C. White, of Georgia, J. L. Snyder, of Michigan, and L. H. Bailey, of New York.

On nomination of J. K. Patterson, of Kentucky, seconded by W. M. Liggett, of Minnesota, E. B. Voorhees, of New Jersey, was unanimously elected president of the association for the ensuing year.

By vote of the association the secretary was instructed to cast the ballot of the convention for other officers, who were declared elected, as follows:

First vice-president, J. C. Hardy, of Mississippi, nominated by J. L. Snyder, of Michigan; second vice-president, K. L. Butterfield, of Rhode Island, nominated by H. C. White, of Georgia; third vice-president, C. D. Woods, of Maine, nominated by W. M. Liggett, of Minnesota; fourth vice-president, E. R. Nichols, of Kansas, nominated by J. H. Worst, of North Dakota; fifth vice-president, E. Davenport, of Illinois, nominated by M. A. Scovell, of Kentucky; bibliographer, A. C. True, of the Office of Experiment Stations, nominated by C. D. Woods, of Maine; secretary and treasurer, J. L. Hills, of Vermont, nominated by H. J. Wheeler, of Rhode Island.

Meeting Place of Next Convention.

E. A. Bryan, of Washington, at the request of President Campbell, of the State University of Oregon, and on behalf of the State of Oregon and the entire Northwest, presented an invitation to the association to hold its next convention at Portland during the Lewis and Clark Exposition.

J. L. Snyder, of Michigan, gave notice that the association would be expected to hold its convention in 1907 at the Michigan Agricultural College, to celebrate the fiftieth anniversary of the establishment of the college.

The session adjourned until 9 o'clock next morning.

Morning Session, Thursday, November 3, 1904.

The meeting was called to order at 9 o'clock a. m. by the president.

Rural Engineering.

W. E. Stone, for the committee on rural engineering, presented the following report:

Since the last meeting of the Association of Agricultural Colleges and Experiment Stations, considerable progress has been made in the agricultural colleges in developing courses under the various names of agricultural engineering, rural engineering, and farm mechanics.

The agricultural colleges of Minnesota, Wisconsin, Illinois, North Dakota, Indiana, New York, Colorado, California, Kansas, Wyoming, and Iowa are now offering instruction to the agricultural students in the subject under one or the other of the above names. Minnesota has completed an inexpensive building which is devoted to the teaching of farm mechanics. Wisconsin has a large building under construction, which is to be used for the same purpose. The agricultural college at Cornell, N. Y., is planning a large and commodious structure to be devoted to agricultural engineering. Illinois has made considerable progress in its farm mechanics course. During the last year the four-story fireproof farm mechanics building at the Iowa Agricultural College has been completed, which, with its equipment, cost over $75,000, and a good course in farm mechanics is offered in the college curriculum. In this course during the spring term 125 students were enrolled.

In the Department of Agriculture progress has been made by adding the department of drainage to the work of the department of irrigation investigation and changing the title to irrigation and drainage investigations.

It is to be regretted that a complete bureau of "Irrigation and Agricultural Engineering" has not been established, which was last year suggested by the committee and recommended by the Secretary of Agriculture. The agricultural colleges that have established courses in farm mechanics have found that great interest is manifested in the work of studying the principles of construction and testing of farm implements. This is true not only of the students and the farmers, but also of the manufacturers of these farm implements, who realize the importance of this work and are offering friendly cooperation and assistance to the work.

An example of what may be accomplished for the benefit of not only the farmers but the manufacturers will illustrate the value of studying farm machinery in colleges. The farm mechanics department of the Iowa State College undertook last year to test various makes of corn planters to note the accuracy of dropping the corn. It was found that there was considerable difference between the different makes and types of planters as to their accuracy of drop. The attention of the manufacturers was called to this fact, and while they were at first thoroughly convinced that their planters were accurate in their work yet they found there was room for improvement, and two firms acknowledged that they improved the accuracy of drop of their planters 20 per cent after their attention had been called to the defects of the planters and a remedy suggested. By means of this cooperation with the manufacturers the farmers of the country are greatly benefited.

While the implement manufacturers of the country are no doubt seeking to bring out the best possible farm implements, yet their interests are from a purely business motive. The department of farm mechanics at the various colleges of agriculture and the Department of Agriculture can do much to further the improvement of farm machinery by making impartial tests and report on the defects to manufacturers. There is at the present time a great demand for information on the cost and efficiency of pumping machinery for irrigation purposes. The large projects of irrigation now under way in the Western States require the pumping of large quantities of water to be lifted from 10 to 200 feet. Thousands of acres of land on the Missouri slope in North and South Dakota can be irrigated if the water can be pumped from the Missouri River cheap enough. Fuel is plenty in those sections of the country in the shape of lignite coal. The Department of Agriculture is performing a service of great value to the Western States by making experiments and collecting facts which will give information to settlers upon the best kind of pumping stations to install to supply the water for irrigation purposes.

During the last couple of years Germany, the Scandinavian countries, and Holland have issued several bulletins which give very interesting data upon tests made of domestic as well as American made farm implements. These bulletins are of great value to those countries, giving as they do the cost of various implements, the amount of work that can be accomplished, and efficiency with which the different makes do the work. Germany has long recognized the value of agricultural and mechanical training both for the farm and for the factory. Our own manufacturers are anxious to obtain graduates from our agricultural colleges who have a knowledge of the requirements of agriculture, together with a mechanical training in the designing of farm implements. Several positions are now open for young men with training along these lines.

There are so many and varied subjects embraced in agricultural engineering that the subject is entitled to a more prominent rank than it now holds in our agricultural colleges. It ought to hold equal rank with the departments of dairying, animal husbandry, agronomy, and horticulture.

It is exceedingly important at this time that the Department of Agriculture take steps to organize a bureau or division of agricultural engineering, in order to aid the colleges which now have a course of agricultural engineering established and to collect the data which such colleges are obtaining in their experimental tests for publication and distribution among the farmers, also to carry on original research and to establish laboratories for practical tests of implements, a museum for farm implements.

The committee again recommends that the association declare itself in favor of the creation of separate departments of agricultural engineering in the colleges; that special efforts be made to assist the Secretary of Agriculture in his endeavor to extend the work along these lines, and that the executive committee use all means in its power to urge upon Congress the importance of this work and to convince them of the necessity of giving the Department liberal appropriations for these purposes.

W. E. Stone, *Chairman.*

W. A. Henry, of Wisconsin. I desire to call the attention of educators along agricultural lines to the great importance and possibility of agricultural engineering. In Wisconsin we have begun to develop these lines and have created a department. I find a large correspondence from the farmer turning into that department already, and we find students turning into the department. We have two students who have elected farm engineering as their major study. The construction of our farm buildings, their adaptation to the purposes required, the proper uses of machinery, the drainage of lands, are all to be considered. You will find, I think, that a department of rural engineering will be a popular one in your college. Let us put in agricultural engineering and be in touch with our farmers. When a farmer wants to make improvements on his farm he will come to the college to get plans, and it should be prepared to furnish them. I believe this to be a very practical means of helping our farmers.

F. M. Tisdel, of Wyoming. I want to state that last year we established at the University of Wyoming a four years' course in irrigation engineering, and it is going to be one of the most important and useful courses in the college.

The report was accepted.

Animal and Plant Breeding—American Breeders' Association.

W. M. Hays, chairman of the committee on this subject, presented the following report:

Your committee on plant and animal breeding accepted the invitation of the American Association for the Advancement of Science, and called a meeting during convocation week in St. Louis, December 29 and 30, 1903, to organize an association. At a meeting of this committee held December 28 a form of constitution and by-laws was prepared by your committee suggesting a plan of organization. Prof. C. F. Curtiss was chosen president and W. M. Hays secretary of the preliminary organization. Over fifty were in active attendance at the meeting, and after full consideration and amendment, the proposed articles were adopted as the organic law, and an organization was effected under the name of the American Breeders' Association. A printed copy of the minutes is submitted herewith.

The plan of organization, like that of the parent organization, consists of a general organization and two subordinate organizations, the one devoted to plants and the other to animals.

The following officers were chosen:

President, Hon. James Wilson, Washington, D. C.; vice-president, Hon. L. H. Kerrick, Bloomington, Ill.; secretary, Prof. W. M. Hays, St. Anthony Park, Minn.; treasurer, Prof. Oscar Erf, Manhattan, Kans.

Animal section: Chairman, Hon. John Dryden, Toronto, Canada; secretary, Prof. F. B. Mumford, Columbia, Mo.

Plant section: Chairman, Dr. H. J. Webber, Washington, D. C.; secretary, Prof. N. E. Hansen, Brookings, S. Dak

This new organization, not having had a meeting since its organization, has not yet had the opportunity to appropriately recognize its obligations to the parent organization nor its future relations thereto.

The fees for annual membership are, for North America, $1; outside of North America, $2; life membership, $20, with a twenty-five year limit on the membership of societies and libraries; patronships, $1,000. Honorary memberships are provided for, and Luther Burbank was given the honor of being the only life member chosen at the first meeting.

A membership committee was appointed, consisting of a general chairman, Mr. E. D. Funk, of Bloomington, Ill., and a chairman and subcommitteemen for each State and province of North America.

The present membership, including a number of European and Asiatic persons and organizations, numbers about 275, of which 15 are life members. The expenses incident to the first meeting and the printing and postage and clerk hire necessary in connection with securing members have required practically all the receipts from annual memberships. Since only the proceeds from annual memberships and the interest income from life membership investments are available for the payment of current expenses, the association is practically without funds with which to publish its first annual report.

The plan adopted for securing memberships has not proven either convenient or effective, and this work is being somewhat more closely centered in the secretary's office, with the chairman and members of the membership committees and others who volunteer to assist in securing members operating through that agency. A card index provides a way of keeping account with each person, society, or institution to whom an invitation to join is sent, and it is proposed that those who should join shall be repeatedly solicited, that a positive or a negative answer may be secured. The multiplicity of organizations to which breeders and scientists belong makes it difficult to secure members.

The association has to offer as inducements to persons to become members, besides the privileges and responsibilities of its annual meetings, an annual report, a business or professional card in the directory in the annual report, the good offices of the association in having the U. S. Department of Agriculture and the experiment stations send to its members such public documents as the directory cards may show that the members are respectively interested in. No doubt other advantageous features will be developed.

The association is determined that a large membership shall be secured. It is in need of help to gain a sufficient number of annual and life memberships so that it will be recognized as having been fairly launched as a strong, conservative, and permanent association. It is also in immediate need of sufficient financial aid to publish its first annual report, for which there is an abundance of excellent material.

W. M. Hays,
L. H. Bailey,
C. F. Curtiss,
H. J. Webber,
Thos. F. Hunt,
Committee.

The report was accepted and the committee was continued for another year.

MILITARY INSTRUCTION.

The following resolution adopted by the section on college work and administration was presented and adopted (see p. 63):

Resolved, That the executive committee be instructed to present the views of the association in reference to military tactics to the President of the United States or to the Secretary of War, or both; or, if it seems preferable to the executive committee, that they be authorized to appoint a special committee for this purpose.

THE UPBUILDING OF AGRICULTURE.

W. Saunders, Director of Canadian Experimental Farms, read the following paper on this subject:

It is not my purpose on this occasion to dwell on the history of the progress of agriculture from early times, but to call attention to some points in connection with the marvelous progress which has been made in the United States and Canada in the knowledge and practice of agriculture within a comparatively recent period.

Agricultural progress in the United States was greatly influenced by the passing of the land-grant act in 1861, by which, through the liberality of Congress, provision was made for the endowment of a college of agriculture and mechanic arts in every State of the Union. The grant was a generous one—30,000 acres for each Senator and Representative in Congress to which such State was entitled at the time the act was passed. It provided that the whole of the money received from the sale of these lands should be invested in safe securities and the interest only used for the maintenance of the college referred to.

The individual States were required to furnish the necessary land and buildings for these institutions, so that the money received from the land granted might be preserved in full as a permanent and substantial endowment fund to be used only for maintenance purposes. Nine million six hundred thousand acres of public lands were thus appropriated, from which a large fund has accumulated.

During the next few years a college of agriculture and mechanic arts was established in accordance with the provisions of the land-grant act in nearly every State in the Union, the land and buildings being furnished by the State or by the liberality of the cities or towns in or near which these institutions were located. In many instances there was associated with the teaching college an experimental farm, where many useful lines of work were conducted. Experiments were carried on in connection with dairying and in the feeding of cattle, sheep, and swine; to test the usefulness of different fertilizers when applied to crops, and to ascertain the relative value of many varieties of grain, grasses, and other fodder crops. Varieties of fruits and vegetables were also tested with the object of finding out in each case the most profitable sorts for the farmers to grow.

After some years of experience it was found that a teaching staff could not satisfactorily discharge its duties to the students and at the same time carry on experimental work with the care and thoroughness which its importance demanded. The teaching was imperative, as the students were gathered primarily for instruction. The experimental work was taken up as opportunity offered, and under such conditions satisfactory progress could seldom be made. At the same time the importance of experimental work pressed on the minds of those who realized how much might thus be done to help the working farmer. Then separate experiment stations began to be organized whose officers were to give their whole time and attention to this work, and the advantages attending this course were soon manifest. Public opinion favored the extension of such work, and in 1887 the Hatch bill was passed by the United States Congress, which, by a liberal yearly grant from the Federal Treasury, provided for the support of a well-organized experiment station in each State and Territory in the Union.

These stations were rapidly organized, and with the further aid of State appropriations were soon actively engaged in many useful lines of experiments bearing on the upbuilding of agriculture. During the seventeen years which have since passed a vast fund of useful information has been accumulated and given to the farming public in reports and bulletins, and the practice of agriculture has thus been assisted in every direction. With a small army of workers engaged in the attempt to solve the various problems which prove a hindrance to the farmer, progress has been rapid, and in every line of agricultural work, conducted under all the varying conditions of climate found in this country, patient investigators have made numerous experiments with the laudable object of finding out how the practice of farmers might be improved and the profits of their business increased. Toward this end the teaching colleges have also lent their influence and aid. The country may well feel proud of these excellent institutions, which have been established on so permanent a basis, and the representatives of both these useful organizations, assembled here to confer together and to discuss matters bearing on the welfare of agriculture, should feel gratified at the high position to which experimental agriculture has attained in the United States.

It would be unpardonable were I to fail to refer to the great work which the Department of Agriculture at Washington has done to stimulate the progress of agriculture. Much of this work has been of a highly scientific character and much of it thoroughly practical. The liberality which the country has shown in the increase of appropriations made for this purpose is remarkable, and, as far as I know, without a parallel. The sum appropriated in 1886 for defraying all the expenses connected with all branches of the work carried on by the Department was $408,810, while in 1903 it amounted to the enormous sum of $5,013,960. In the meantime the number of officers in the main divisions of the work has been largely increased and the divisions subdivided. Many new lines of work have been taken up and investigations conducted in nearly every part of the United States and its colonies.

In Canada also some progress has been made in the upbuilding of agriculture. Twenty years ago agriculture was in a very depressed condition in Canada and much concern thereby awakened. The importance of a prosperous condition of agriculture there is difficult to overestimate when we consider that about one-half of the population are engaged in agricultural pursuits and that agriculture is the mainstay of all other industries. In 1884 the House of Commons appointed a select committee to inquire into the best means of developing and encouraging the agricultural interests of Canada. This committee made a careful inquiry into the subject, also as to the disadvantages and wants experienced by farmers, taking evidence from various persons who had made a special study of the different branches of industry included under the general term agriculture, and of others having a scientific knowledge bearing on this subject. In the report subsequently submitted to the House of Commons the substance of the evidence accumulated is thus summarized:

"Notwithstanding the great progress made in recent years, it appears that there is a large amount of defective farming in this country. In the cultivation of cereals, roots, and grasses there is want of periodical change of seed, selection of improved varieties, a proper rotation of crops, with a lack of thorough tillage and a knowledge of the value and suitability of manures. The value of manures is in many cases unheeded, and much fertilizing power is lost through negligent exposure and the waste of liquid manures. In stock raising the chief deficiencies are the want of pure-bred males, lack of knowledge of the adaptability of breeds to particular conditions throughout the Dominion, the want of better pasture and more abundant tree shelter. In the production of butter the milk is frequently not properly cared for, nor is suitable attention paid to the selection of milch cows, and the food given is often deficient in nutriment and in milk-producing qualities.

"Low grades of butter are attributable to want of skill in its manufacture and want of improved apparatus. In cheese making the need of greater skill and want of scientific knowledge is also felt. In the cultivation of fruit a great want is experienced in many sections of hardier varieties and of varieties with improved keeping qualities. There is also a deplorable want of knowledge regarding the insects and diseases injurious to fruit trees."

Careful investigation led to the conclusion that the lack of success was not due to any fault in the soil or climate of this country nor to a want of industry among the farmers, but to defective farming, to want of skill and knowledge in all departments which the farmer of himself was scarcely able to remedy.

The committee recommended that the Government establish an experimental farm or farms where experiments might be carried on in connection with all branches of agriculture and horticulture, and that the results of the work conducted should be published from time to time and distributed freely among the farmers of the Dominion.

The recommendations of this committee were acted on. Information was first obtained regarding experimental stations then in operation in Europe and America and the methods pursued by them in their efforts to gain information valuable to the farmer and early in 1886 an act was introduced and passed almost unanimously, authorizing the Government to establish a central experimental farm and four branch farms. The central farm was to be located at or near the capital, Ottawa, where it was to serve the purposes of the two larger provinces, Ontario and Quebec. The branch farms were to be distributed as follows:

One for the three maritime provinces jointly, Nova Scotia, New Brunswick, and Prince Edward Island; one for the province of Manitoba; one for the Northwest Territories, and one for British Columbia. The work to be undertaken at these several experimental farms was set forth in the act and covered all lines of experiments relating to agriculture, horticulture, and arboriculture.

Within two years the land for the several farms was secured, the necessary officers appointed, most of the buildings erected, and the farms put in practical operation. The central farm was located near Ottawa, the branch farm for the three eastern provinces at Nappan, Nova Scotia; that for Manitoba at Brandon; the farm for the Northwest Territories at Indian Head, in Assiniboia, and that for British Columbia at Agassiz, in the coast climate of that province.

In the choosing of these sites the purpose in view was to have them fairly representative of the larger settled areas in the provinces or territories in which they were placed both as to soil and climate. In the arrangement of the work such experiments as were most likely to be beneficial to the larger number of settlers were in each case among the first to engage the attention of the officers in charge.

Eighteen years have passed since this work was begun, and during that time agriculture in Canada has made unprecedented advancement. It is not claimed that this progress has been wholly due to the influence and work of the Dominion Experimental Farms; much credit is justly due to the various measures carried on by other useful organizations established mainly by the several provinces.

Foremost among these is the Ontario College of Agriculture at Guelph. This is a well-equipped institution which has done noble work. Farmers' institutes, live-stock associations, fruit growers' associations, and agricultural and horticultural societies have all proved helpers in this good cause. The commissioner's branch of the Dominion department of agriculture has also been an important factor. This branch deals with the cooperative dairy interests, the development of cold-storage facilities by which certain food products can be carried in good condition to the markets in Great Britain, the inspection of fruits, seeds, etc. There is, however, no doubt that the experimental farms established by the Federal Government have contributed in large measure to the general upbuilding of agriculture in Canada. The progress referred to has resulted in a general improvement in the condition of the agricultural population all over the country and in a vast increase in the exports of agricultural products.

There is probably no employment which engages man's attention that requires more skill and more general information than farming. Competition is keen throughout the civilized world, and the farmer must turn to practical account every advantage within his reach bearing on improvement in the quality of his products and in lessening the cost of their production, if he is to maintain and improve his position.

Investigations and experimental research have been conducted on almost every line bearing on agriculture, and a great mass of important facts has been accumulated and given to the farming community in reports and bulletins.

When the experimental farms were planned it was intended that they should become bureaus of information to which farmers could apply from time to time to aid them in the solution of difficulties which frequently present themselves during the progress of farm work. Evidence of their usefulness in this way is furnished in the rapid increase of correspondence carried on with farmers in all parts of the Dominion. In 1889, the year after the farms had become fairly organized, the number of letters received was about 8,000. During the past six years the average number annually received at all the experimental farms was 66,222. In addition, over 220,000 reports and bulletins have been sent each year. There is thus a constant flow of information going to Canadian farmers from all the experimental farms.

It is as a rule a difficult matter to bring about rapid changes in the ideas and practice of farmers, but as soon as they are convinced that experimental work is carried on in a practical manner by persons competent to give information, that it is undertaken in their interest and with the special object of making farming more profitable, their sympathy and cooperation are assured.

Experimental agriculture covers so large a field that I can but briefly refer on this occasion to a few important points in connection with the work which has been done for the upbuilding of agriculture in Canada, such as will indicate the general trend of the work.

The principles which underlie successful crop growing may be thus summarized: Maintaining the fertility of the land, adopting a judicious rotation of crops, following the best methods of preparing the land, early sowing, choosing the best and most productive varieties, and the selection of plump and well-ripened seed. Along all these lines many experiments have been conducted.

Continued efforts have been made to gain knowledge as to the best methods of maintaining and adding to the fertility of the land. In this connection special attention has been given to investigations to determine the best methods of handling and using barnyard manure—the universal fertilizer, which is more or less available everywhere to the farmer.

Experiments continued for eleven successive years have shown that a given weight of manure taken fresh from the barnyard is equal in crop-producing power to the same weight of rotted manure. It has also been shown by repeated tests that fresh manure loses during the process of rotting from 50 to 60 per cent of its weight. The effective use of barnyard manure so as to obtain the best results with the least waste is without doubt one of the most important problems connected with successful agriculture, for on this material the farmer's hopes of maintaining the fertility of his land and thus providing for a succession of good crops are mainly based. It is estimated that the manure produced in the solids and liquids of animals in the United States will probably amount to about 1,000 million tons annually, and that in Canada to about 100 million tons. The financial loss involved in the wasteful handling of such a vast amount of valuable material should impress us all with the importance of this subject.

Tests for eleven years were also carried on with artificial manures to gain information as to their relative value when used separately or in combination on nearly all the more important farm crops. The results had from artificial fertilizers used alone have been disappointing, considering the large proportion of available plant food they contain. The reason for this lies probably in the fact that these fertilizers contain no humus and that the proportion of vegetable matter in the soil has been much reduced by constant cropping and the capacity of the soil for holding moisture lessened, to the detriment of its crop-producing power.

The plowing under of clover has been most effective as an additional source of fertility. It increases the store of available plant food by the addition of nitrogen obtained directly from the atmosphere. It also adds to the mineral plant foods available by gathering these from depths not reached by the shallower root systems of other farm crops. It also serves as a catch crop during the autumn months, retaining fertilizing material brought down by the rain, much of which would otherwise be lost. It also supplies the soil with a large addition of humus whereby the land is made more retentive of moisture, and results in a deepening and mellowing of the soil.

In a series of 14 plats of oats, covering a period of five years, where clover was sown and plowed under on alternate plats, the plats with clover gave an average increased yield of grain of about 9 bushels. In a similar series of plats of barley where grown after clover there was an average gain of 8 bushels and 31 pounds per acre. In all these plats there was also a considerable increase in the weight of straw produced. Proportionate gains have also been made in trials with Indian corn and potatoes. Many other examples might be given.

In preparing land for crops different methods are adopted in different parts of the Dominion. In the eastern provinces the fall plowing of land is now generally followed, as crops can be sown earlier by the adoption of this method. On the Northwest plains it has been found of great advantage to summer-fallow a part of the land each year. This practice conserves moisture, destroys weeds, and brings the farmer much larger crops. The yield of wheat on land which has been summer-fallowed will average fully one-third more than it will on land which has been prepared by fall or spring plowing.

That increased crops result from early sowing has been fully demonstrated by the tests carried on at the central farm. Experiments with early,' medium, and late sowings were conducted for ten years on plats of one-tenth acre each, sowing two varieties each year of wheat, barley, oats, and peas. The land was very uniform and all similarly prepared. Six sowings were made in each case, the first at the earliest time practicable, the second at the end of a week, and others at the end of each subsequent week until six successive sowings had been made. These plats were all harvested and thrashed separately and the results recorded. The best crops have been had from the second sowings, made just one week after it was possible to get on the land; beyond this delay has resulted in loss, which has become more serious as the delay has been greater. The average of the ten years' experiments shows that with wheat a delay of one week after the period named has entailed a loss of over 30 per cent, two weeks 40 per cent, three weeks nearly 50 per cent, and four weeks 56 per cent of the crop.

With oats a delay of one week has caused a loss of over 15 per cent, two weeks 22 per cent, three weeks 32 per cent, and four weeks 48 per cent.

In the case of barley a delay of one week has resulted in a loss of 23 per cent, two weeks 27 per cent, three weeks 40 per cent, and four weeks 46 per cent.

With peas a delay of one week has caused a loss of 4 per cent, two weeks 12 per cent, three weeks 22 per cent, and four weeks 30 per cent.

The results of these experiments have been widely published and farmers in the East now pay general attention to early sowing.

Another important consideration in connection with successful farming is the selection of the best varieties of seed for sowing, taking into consideration productiveness, quality, and earliness of maturing. That there are varieties more productive and earlier in ripening than others has been abundantly proven.

During a five years' test of 41 varieties of oats, all of them sown each year on the same day and on adjoining plats, the results have shown the relative productiveness of certain sorts. Each year a list has been published of the heaviest-yielding 12 in the series, and during the whole period of five years only 15 of the 41 varieties have found their way into this select list, and 9 of these have appeared among the best 12 every year.

Similar evidence has been furnished with spring wheat, 31 varieties of which have been under trial for a like period. In this instance 16 of the 31 sorts have appeared among the best-yielding 12 during the five years' trial and 9 of these varieties have appeared each year in that list. The evidence as to persistent productiveness in certain varieties of barley is still more striking.

In the oat plats the difference in crop is large, ranging from 89 bushels to 42 bushels. Spring wheat has ranged from 31 to 16 bushels, barley from 58 to 33 bushels, and peas from 46 to 20 bushels.

The importance of growing those varieties which will give the largest crops is manifest when we consider the very large areas under cultivation. Taking the acreage in Canada alone devoted to the oat crop, which is very small compared with the United States, an increase there of a single bushel per acre to the average crop adds to the profits of Canadian farmers over a million of dollars.

But it may be asked, How can farmers procure these prolific strains of seed? The following is the method pursued in Canada: After careful and continued experiment has shown that any variety is specially productive and promising, this is cultivated on a larger scale so as to admit of the free distribution of samples among the farmers of the Dominion. This grain is grown chiefly at the branch experimental farms in the west and distributed from the central farm at Ottawa, where the samples can be sent free through the mail. They are sent out in strong cotton bags, the quantity of oats forwarded to each applicant being 4 pounds, and of wheat and barley 5 pounds, sufficient in each case to sow one-twentieth of an acre. These samples are sent only on personal application, and only one variety can be had by an applicant each year. Under this restriction the number of samples sent out during the past eight years has averaged 36,684, requiring about 70 tons of seed annually. Last year this distribution reached over 40,000 farmers, and the interest felt in it is steadily increasing.

Not only is the grain sent out of high quality, but it is also thoroughly clean. If a farmer takes reasonable care of the sample he receives, he can soon have sufficient seed to sow a large area for himself and have a surplus to sell to his neighbors. This may perhaps be best illustrated by two or three extracts from correspondents regarding oats, representing a large number of such letters received. Similar testimony in regard to samples of wheat and barley could be given.

A farmer from Dauphin, Manitoba, writes: "The sample bag of 4 pounds of oats sent me two years ago gave me the first year 5 bushels. This year we sowed these on 2 acres, and we got 217 bushels."

A correspondent from Laurel, Ontario, says: "We got a sample of oats from you six years ago, and they gave us great satisfaction. The people about here think very highly of them, and there are thousands of bushels of them grown. The farmers are coming here for seed for 20 miles around."

Another farmer from Carleton Place, Ontario, says: "The oats I got from the experimental farm some years ago have been worth a great deal of money to me, in increased yield and increased price, as I have sold quite a quantity for seed."

Another farmer from Piedmont, Nova Scotia, writes: "The oats, of which a sample was received three years ago, proved an excellent variety. I had 420 bushels last year. They yielded 74 bushels to the acre."

It is thus apparent that with attention and care any farmer may soon provide himself under this liberal arrangement with the best and most productive strains of seed in sufficient quantities for a large area at no cost to himself beyond that of his own labor.

The recent increase observed in the yearly average of cereal crops in Canada, which is very considerable, is no doubt due in large measure to the more general cultivation of highly productive varieties brought about by these annual distributions.

Many varieties of grain have been brought to Canada for test from nearly all the grain-growing countries in the world. This has been done with the hope of finding varieties equal in quality and productiveness to the best of those now in cultivation and earlier in ripening. Some wheats have been brought from northern Russia and other northern parts of Europe; some from high altitudes in India; others from England, France, Germany, Hungary, the United States, Australia, and Japan. The wheats from northern Europe and from India have usually ripened in a shorter time than the Red Fife, which is one of the best sorts in general cultivation in Canada, but most of them have been inferior in quality and productiveness.

During the progress of these experiments many cross-bred wheats have been originated with the object of combining the good qualities of two or more varieties. In most of these crosses Red Fife has been used as one of the parents on account of its high quality and productive character.

One of the early introduced sorts from Russia was the Ladoga, which was, on an average, a week earlier than the Red Fife. This was unacceptable on account of the yellow color of the flour made from it, but it was crossed with the Red Fife and a number of new sorts produced. One of these, known as Preston, has exceeded the Red Fife in yield during a test of eight years by 1¾ bushels per acre, and has ripened on an average about four days earlier.

Another variety, known as Early Riga, was obtained by crossing one of the East Indian varieties procured from an elevation of 11,000 feet in the Himalayas with a Russian wheat brought from near Archangel, one of the most northerly wheat-growing districts in Russia. These were both early ripening sorts and were of good quality, but were not sufficiently productive. The Early Riga ripens about ten days earlier than the Red Fife or the Blue Stem, and is fully equal if not better in quality, but the yield, although good, is not quite so heavy.

These gains in earliness are of great importance in Canada, in view of the immense territory we have lying north of the present wheat fields. Such varieties will no doubt serve to materially extend the area of successful wheat growing. About 1,000 new varieties of wheat have been produced at the Canadian experimental farms in the manner indicated, and among these there are many promising sorts.

Experiments have been conducted for a series of years to ascertain the quantity of seed grain most profitable to sow per acre, the depth in the soil at which the seed should be placed in the different climates in the Dominion, and the relative advantages of sowing with different sorts of drills as compared with broadcast seeding.

The object lessons which have been given in the raising of fodder crops and the making of silage, thus providing cheap and succulent food for cattle during the winter, have greatly stimulated the dairy industry, especially the manufacture of butter in winter. The experiments carried on with reference to the care of milk and the economical production of butter of high quality have received much attention from those engaged in dairying. The experience gained in the economical feeding of cattle, swine, and sheep, and in testing those breeds best adapted to produce the highest quality of beef, pork, and mutton, has stimulated and aided the stock industries. The business in eggs and dressed fowls for the table has also been advanced by the publication of the results of experiments in the poultry branch.

The instructive tests which have been made with large and small fruits have served to show where these can be grown to the greatest advantage, and have been helpful in promoting fruit growing over those large areas in Canada where the climate is so well adapted to the growth of fruits of high quality.

Special efforts have been made to meet the difficulties which arise in the more northern districts where the better classes of existing fruits prove too tender. For such localities new sorts have been produced by the cross fertilizing of very hardy wild Siberian forms with some of the hardiest of our cultivated apples. It has been shown that such cross-bred fruits are hardy enough to endure the climate in all the settled parts of the Canadian northwest.

The information which has been given on the growing of vegetables and the varieties best suited to the different climates of the country has proved very helpful. Many practical experiments have been conducted in the growing of forest trees to furnish shelter for exposed situations. Large quantities of young trees and tree seeds have been distributed among farmers in those districts where trees are scarce. Some limited distribution has also been made of ornamental trees and shrubs with the view of encouraging the adornment of homes and making them more attractive.

Much information has been given as to the best remedies for the destruction of noxious insects and for resisting the attacks of fungus diseases from which grain, fruit, and other crops suffer so much. The subject of noxious weeds has also been investigated and the best measures pointed out for their subjugation.

In the chemical division investigations have been conducted on many lines bearing on the agricultural interests of the country and the help thus rendered to farmers has been greatly appreciated.

Much of the practical information gained each year by the lines of experiments conducted is given to the farmers in the annual reports and bulletins issued. Many thousand farmers also visit the farms each year. The officers of all the farms also attend meetings of farmers held in different parts of the country, where opportunities are afforded for giving fuller explanations concerning all branches of the work in progress.

In the meantime the upbuilding of agriculture has progressed rapidly and the occupation of farming has been elevated in the eyes of the community. It is no longer looked upon as a drudgery where the dull and slow-going may eke out a laborious existence; it is now recognized as a suitable field for the exercise of the higher intelligence of more cultivated minds, as a calling requiring much skill to conduct it successfully.

While the demands of the home market for food products are immensely greater than they were twenty years ago, the export of farm products has greatly increased. In 1884 the total export of wheat and flour from Canada was about a million dollars; in 1903 it was over 29 millions. The export of cheese, which at that time was about 7 millions, has increased to over 24 millions. The export of pork, bacon, and hams has run up in the same time from about half a million to over 16 million dollars. The exports of fat cattle have more than doubled and large increases have been made in almost every other line.

There are still opportunities for improvement. Nowhere have we reached a stage approaching perfection, and I know of no pursuit more noble than that which is so fully represented at this convention, that of striving to add to the happiness of mankind by helping the tillers of the soil by precept and experiment to improve their condition, thus making the earth to yield more bountifully, producing food products in larger quantity and of better quality for sustaining the teeming millions now occupying the surface of our globe.

The programme committee for the college section not having been selected by that section the chairman and the secretary were authorized to fill the committee by the selection of one additional member to act with themselves.

On motion of E. B. Voorhees, of New Jersey, the annual dues of each college and station constituting the association were fixed at $15 for the year 1904–5.

INDEXING AGRICULTURAL LITERATURE.

E. W. ALLEN, of the Department of Agriculture. In the report of the committee on indexing agricultural literature, which was read by Professor Hays (see p. 32), reference was made to the indexing of periodical literature relating to agricultural science. This work was undertaken at the instigation of the experiment stations, there having been considerable demand for an index to scientific literature not covered by any indexes we now have. The current work of the periodicals is, as you know, reviewed in the Experiment Station Record, and our indexes at the end of a year or end of the period cover that current work and make it easily accessible. In order that the looking up of work that has been done in the past on particular subjects might be simplified, Miss Clark, the Librarian of the Department, has undertaken, at the request of this committee, to prepare an index of the scientific periodicals published in Europe and in this country relating to agricultural science and has secured an additional appropriation from Congress in order that she might carry on this work with less interference. She has now assigned a regular cataloguer to the work and is going forward systematically. As the report referred to stated, arrangements have been made with the Library of Congress to print these cards. The printing of the cards has been undertaken, and a circular has been sent out to the institutions announcing the index and the terms on which it can be subscribed for. These are very liberal, but a small fee is required because it is not the custom of the Library of Congress to give away its cards, believing people usually appreciate it more if they pay a small sum. The cards have been classified by subjects in such a way that a person who does not desire a complete set can get those relating to a particular topic. A person who is interested in a library on plant diseases can subscribe for all the cards on plant diseases, and so on. There has been considerable response to the circular sent out, but it has not been sufficiently general so that we feel warranted in concluding that it has come to the attention of the people as widely as it should.

C. F. Curtiss, of Iowa, stated to the convention that a special train had been provided to carry the members of the convention to Ames to visit the Iowa Agricultural College, and that all were invited to join in the trip.

Resolution Regarding Director True and the Office of Experiment Stations.

C. D. Woods, of Maine, offered the following:

It is with great regret that the association notes the absence of Director True of the Office of Experiment Stations from this convention, and the association hereby tenders him its appreciation of his untiring and successful endeavors in behalf of this association.

It also takes this opportunity to commend the various lines of work of the Office of Experiment Stations under his charge, and notes in illustration the work of the division of nutrition in its study of the nutritive value of the food of man as a line of work in cooperation with a number of the institutions here represented and of great practical as well as scientific importance which might, to public advantage, be extended.

The resolution was adopted.

Resolutions of Thanks.

M. A. Scovell, of Kentucky, presented resolutions of thanks to those who had contributed to the success of the meeting, which were adopted.

On motion of H. C. White the thanks of the association were returned to Mr. Saunders for his interesting paper, and it was ordered that the address be made a part of the proceedings of the convention.

On motion of W. E. Stone, of Indiana, the thanks of the association were returned to the retiring president. W. O. Thompson.

On motion, the convention then adjourned sine die.

MINUTES OF THE SECTIONS.

SECTION ON COLLEGE WORK AND ADMINISTRATION.

AFTERNOON SESSION, TUESDAY, NOVEMBER 1, 1904.

The section was called to order at 2 p. m. by the chairman, W. E. Stone, of Indiana.

The following paper was presented by W. O. Thompson, of Ohio:

HOW FAR SHOULD OR MAY LAND-GRANT COLLEGES ENGAGE IN TEACHING ELEMENTARY SUBJECTS NOT GENERALLY RECOGNIZED AS BELONGING TO THE COLLEGE CURRICULUM?

The discussion of this topic involves an interpretation of the Morrill Act. I shall first give some attention to that phase of the discussion, and here let me remark:

I. The word "college" at the time of the Morrill Act signified an institution of higher learning for which certain prescribed academic studies were required as a condition of entrance and in which institutions there were certain studies chiefly prescribed which were pursued as a condition of a baccalaureate degree. From a practical point of view the word "college" was clear and distinct. We recognize that historical and traditional idea. When we come, however, to make application of this term, we are compelled to recognize also that a standard for entrance or basis on which the college was built was far from uniform. This variation was so great that the degrees of some colleges would require a little more than the entrance requirements of to-day. I make mention of this condition in order to make one other remark, namely, that the discussions in Congress could not, therefore, be interpreted as signifying an institution of such standard as would be beyond the prevailing conditions of the college at that time. It is true that this prevailing idea did not imply very much as to the grade of teaching or as to the method of teaching. It would be safe to assume that neither the method nor the standard would be regarded as satisfactory in the college of to-day. This leads me to say, therefore, that very little can be drawn from the word "college" as occurring in the statute. So far as the discussion in Congress might be regarded as influencing this decision, I should say that the word "college" could be interchanged with the word "school" and do no great violence to the conception prevalent at the time the Morrill Act was passed.

II. A further interpretation lies in the modifying phrase, "to teach such branches of learning as are related to agriculture and the mechanic arts."

It would seem from this statement that Congress made no effort to define the term "college," but rather to indicate in a general way the lines of work that were to be pursued and to be given special emphasis. The term "branches of learning as are related to agriculture and the mechanic arts" is a very broad and indefinite statement. It is noticeable that these branches are not even named. It is doubtful whether many in Congress could have named the subjects, even, or could have recognized them if they had been named. It is true that the discussions in Congress did emphasize the importance of maintaining the fertility of the soil and improving the live stock of the country, but the various subjects now regarded as "related to agriculture" and as of the highest importance are quite beyond the conception in the mind of Congress. Indeed, we recognize that there has been a considerable development in the colleges themselves in the way of minute classification as well as in interpretation of subjects not then in the minds of the founders of these colleges. We are disposed, therefore, to assume that these men, looking at the subject in a broad and general way, were willing to leave it to the natural development that would come from the influence of such institutions when organized. This would assume that a higher grade of work than was contemplated at that time is probably done at this date. Our theme looks the other way and makes the inquiry whether a lower grade of work than would be recognized in our time as college work could be admissible as meeting the terms of the act.

I may add that the same remark could be applied with equal force concerning the subjects related to the mechanic arts. The one subject of electricity would be sufficient to illustrate that much work now being regarded as perfectly logical and exactly within the terms used in the statute, was at the same time entirely without the horizon of most men at the time the act was passed.

Further, it is noticeable that the statute provided that the subjects should be taught; that it neither makes nor suggests any idea as to the grade of instruction—that is, whether it shall be collegiate or preparatory—but that the emphasis is put clearly upon the teaching of these subjects. It is plainly upon the surface of the statute that these subjects were new subjects of study and instruction. The colleges that were to teach them were making a new departure, and were introducing the study of branches hitherto almost entirely neglected. It seems clear, therefore, that we may safely assume that the teaching of the subject meets the statute whether it be done in an elementary or in a more advanced way.

III. A further interpretation is suggested in the phrase, "in such a manner as the legislatures of the States may respectively prescribe." It is a matter of some importance to note that in the discussions of this bill and in the veto message of President Buchanan there was serious objection raised on the ground that education was a matter in which the local government should have supreme control. It was argued that a federal government had no right to interfere or to restrict in any way the rights and privileges of the States in the matter of education. This old argument is still used against the organization of a national university. It seems fair, therefore, to say that this phrase now under consideration left the whole question of the manner of teaching to the several States, and that it was an effort to avoid an unpleasant debate in Congress, which might have defeated the bill. Assuming this statement to be true, it seems entirely clear, therefore, that the several States must teach the subjects, and that the manner of the teaching is wholly a matter of local jurisdiction. This allows large liberty as bearing upon the question of elementary and advanced discussions. It assumes that each State knows how money can be expended most wisely within its borders in order to reach the general ends outlined in the statute. It would be assumed then, as it would be assumed now, that the conditions in the several States would vary, and that what was wise in one instance would not be in another. There is a substantial unity in these agricultural colleges, but there is no such thing as absolute uniformity. The statute is general in its statements, and wisely so. The chief problem is, therefore, to so interpret the statute that it may in the several localities do the thing desired, namely, teach certain subjects, and through instruction in these subjects awaken a new interest, perpetuate good conditions, and make way for improvement.

IV. We are interested in one other phrase: "In order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." The several terms in this phrase offer opportunity for a wide discussion, but attention is called to one or two features only.

(1) The expression "practical education" was evidently intended to supplement the word "liberal," which then had a very distinctive meaning. A liberal education was not then assumed to be a practical matter, as it now is. Most men now regard a liberal education as a thoroughly practical one. At that time a little different conception existed in the minds of most people. The expression "practical education," therefore, was supplementary, and suggested in a broad way that new subjects were to be introduced into these colleges and a new emphasis put upon the importance of a so-called practical education. The general idea in this practical education was that it should prepare men to do things. The liberally educated man was a thinker; the practically educated

man was to be a worker. In so far, therefore, as either agriculture or the mechanic arts prepare men to meet these requirements they may be regarded as practical education within the limits of the statute.

(2) The industrial classes are here specifically named. It seems a natural interpretation, therefore, that we were to have a working education for a working people. The expression "the several pursuits and professions of life" intimated that all classes would be benefited by these colleges and that they were expected to dwell together in the pursuit of education. It was clearly expected that those studying the branches of learning related to agriculture and the mechanic arts, being of the industrial class, would be made more efficient in the several pursuits of life and that many of them would probably enter the so-called professions of life. It is probable also that this statute permits us to say that the various subjects here taught would introduce one to professional life within the limits of that education. It would probably be a little too much to urge that the statute anticipated the profession of agriculture or the profession of mechanic arts. It does, however, seem entirely clear that the agricultural colleges were expected to make more efficient farmers and that the colleges of mechanic arts were expected to make more efficient men in the field of mechanic arts.

From these discussions of the statute I now pass to a more specific reply to the question in the topic under discussion, namely, "how far may these colleges engage in teaching elementary subjects," and here I remark:

(1) That I see no reason why the colleges of mechanic arts should be put under any rule more restrictive than the rule now in force in colleges of liberal arts throughout the country. It is well known that with the changes that have occurred in our entrance requirements and with the introduction of the elective idea in college it has become necessary for many subjects to be begun in college. Among these you will find listed some subjects that are accepted for entrance requirements that were formerly prescribed for entrance requirements. Most colleges now give opportunity for beginning the study of Greek. They also give facilities for the study of modern languages. They also give facilities for the beginning of the study of chemistry. We may say that this is not elementary teaching or that these subjects are not elementary, but that is a mere evasion of the facts. Many a student gets his first insight in these subjects after matriculation as a regular college student. I see no reason, therefore, why the beginning of a subject may not be made in the colleges of agriculture and mechanic arts with as much propriety as in a college of liberal arts.

(2) Our topic suggests elementary subjects not generally recognized as belonging to the college curriculum. As a matter of fact there are very few such subjects. All science belongs to the college curriculum. Elementary physics is as truly physics as advanced physics. The same may be said of any other science. The same argument would apply in the matter of language, whether it be ancient or modern. So far, therefore, as the legal right of doing such things is concerned, it seems that the word "elementary" or "advanced" is not important. The real question is whether the subject itself comes within the meaning of the statute. The provisions of the second Morrill Act are interesting as in a way interpreting the whole situation. This second act recognizes the propriety of teaching English, economics, and certain other subjects, but seems to draw the line against the use of money for certain classical purposes.

(3) The significance of the statute, too, must be interpreted in the light of the classes for which the colleges were founded. Evidently the children of farmers were chiefly in the minds of Congress at the time of the discussions. As I have had occasion to say elsewhere, mechanic arts was mentioned in the discussion, but not with any great emphasis. The appeal was made largely from the view point of agriculture. Now, it would not be fair to assume that the persons who are to be benefited by the college of agriculture were persons whose educational attainments rendered elementary teaching unnecessary. That was not the condition of rural education at that time, and we regret to say that it is not the condition now. To make such interpretation, therefore, would be to impose upon all the coming students of agriculture the necessity of an education that is not now within their reach. It would imply the development of rural schools to a point quite beyond the present. The same principle would hold if we were to think of the children of industrial classes as the beneficiaries of the colleges of mechanic arts. Now it is emphasized that these colleges were to meet conditions existing in the country and provide a type of education in which Congress

expressed a profound interest. There was no effort to set up a standard for these colleges and demand of the public that they should meet that standard. The truth is the colleges were to meet a condition. This makes it all the more imperative that the question should always be a local one. In some States where rural education and village education has reached a high degree of efficiency the colleges might well take a stand and be justified in it, that would be thoroughly unjustifiable in less favored States, or where the elementary education is not so well organized.

(4) In conclusion I may say that the only rule by which we can be guided in such cases would be an honest effort to meet the conditions of the State in which the college is located. I believe it to be the duty of these colleges to use their influence to improve these conditions as rapidly as possible. Such improvement would relieve the college of some work now necessary and give it opportunity to become more efficient in the designated fields of agriculture and mechanic arts. This condition forms a solid argument on the part of these colleges in appealing to their several States for maintenance and development of a system of rural education which will make the colleges more efficient. Already a movement in the interest of agriculture in the rural schools has made some progress. This is representative of what may be done when an interest has been aroused among the people which shall result in such preparation as will make them better able to take full advantage of their colleges of agriculture and mechanic arts.

R. W. Stimson, of Connecticut. Let me emphasize one or two points which have been raised in the paper to which we have just listened.

What did Congress intend the agricultural colleges to be? The second Morrill Act was passed for the further endowment and support of the land-grant colleges. I have read very carefully all of the debates and discussions in connection with the passage of the act, and I can not find a serious attack upon the land-grant colleges as they then existed. In case of some of the colleges and departments connected with other institutions there was serious debate and some criticism on the ground that land-grant money was being used for teaching subjects which were not obviously and immediately for the benefit of agriculture and the mechanic arts. There was no good reason why the Federal Government should give more money, therefore, for duplicating means of education which could be had in other institutions as well as in the land-grant colleges. There was no criticism of the grade of instruction, nor of the curriculum of the land-grant colleges.

Now, the land-grant colleges in 1890 had no uniform standard of entrance requirements. Some were requiring a part of a high-school course for admission. The vast majority of them, however, were admitting their students directly from the common schools to the college course. If that is true, and if the act says that the act of 1890 was passed for the further endowment and support of the land-grant colleges, is it not clear we may teach anything we please so far as grade of instruction is concerned, and provided only we keep the specified subjects? It seems to me that the affirmative is true on that point.

It seems to me that the history of the land-grant colleges since 1890 has been largely a repetition of the history of those institutions between 1862 and 1890; that is, that we have practically the same sort of institutions to-day as then existed. That would seem to indicate that Congress was right in not criticising these institutions and in spending money for the further endowment and support of this style and grade of education. In the discussions and debates of Congress on these measures, I think you would find that the term "school" and the term "institution" were used quite as often as the term "college." On the whole, then, I am forced to the conclusion that Congress intended that we should teach what the land-grant colleges had been teaching prior to 1890, and that therefore we have a free hand in doing so.

A clause of the act of 1890, however, limits the curriculum to specified subjects; but it is understood that in the Senate that clause was very earnestly debated and the original restrictive clause was thrown out. It, was, however, restored in the House, it is said, under pressure of the National Grange, and was finally accepted by the Senate in its present form. I bring this to your attention to indicate, what seems to me to be true, that this clause was prompted by an effort not to determine the grade of instruction, but to determine that these institutions to be further endowed and supported should be turned toward the industries of life rather than toward the liberal arts and professions of life in the ordinary sense of the term.

What ought you and I to do to-day with all this freedom?

In Connecticut we have two sets of boys who ought to come to our institution—boys who have been in the common schools and who have had no high schools within reach, and boys who have been in the high schools, and who are going to some sort of college, who by taste and inheritance ought to come to our institution. We had only a four-year course. We had a little agriculture in every year, and a considerable of the elements of liberal education in all the years. The result was that the boy coming from the high school had to go back, if he wanted to get our agricultural instruction, and start at the same point where the boy from the common school would start. You see what difference there was in the matter of training and mental ability. It seems to me the mental ability a man has counts for vastly more than the subjects he studies. We do not care where a man gets his brain power. If he has got it and can apply it to agriculture and mechanic arts we are ready to receive it and put it to work. But we wanted to put in the proper place the man who had not developed his brain. So we hit on this scheme. I asked a committee of the faculty to work out a two years' course of preparation for farming. They worked out a two years' course in farming open to graduates of high schools. Our curriculum as it stands to-day divides our studies into three groups of two years each. We offer attractive courses to boys who have a limited amount of education, and to boys who find it in their power to get considerable education.

In addition to this, in special subjects we give short courses varying from ten days to a year. We have found since we introduced these courses that we have come closer to our natural constituency; we have the respect of the practical farmer as we never had it before, and our short courses have fed our long courses. Besides our short-course work in the winter, we have been holding a summer school for teachers and others, in which we have limited our subjects to nature and country life, and we have had three very successful sessions.

It seems to me there is a good field for the land-grant college, and that each State may and ought to organize its land-grant college so as to meet the needs of its peculiar constituents, and that anything and everything which it is found practical to teach within these limits should be taught.

I have not spoken of extension work. I do not believe extension work is a proper use of the land-grant college money. That is, we hold that anything you can teach at the college in connection with your college courses is appropriate and may be paid for out of your land-grant college money. We do not do any extension work at the expense of the Federal Treasury. Of course we understand that each State college is perfectly free to use the money it receives from its own legislature and its own State treasurer for any purpose the State may designate.

W. A. Henry, of Wisconsin. President Stimson is entirely right when he says that the Grange was back of those limitations in the Morrill Act of 1890. The argument was that many of the colleges had diverted much of the first appropriation to purposes not closely connected with instruction in agriculture and mechanic arts, and to give more money without restriction would be to simply give further impetus in the wrong direction.

R. H. Jesse, of Missouri. I feel compelled to emphatically dissent from much that has been said on this subject.

I take it that Congress knew what a college was just as well as we know what a college is: that Congress said what it meant and meant what it said when it established colleges of agriculture and mechanic arts. It is very true that the standards of admission to college at that time were not what they are to-day. But college meant as truly then as it does now an institution that is based upon secondary education. And if the colleges were not up to their present rank, the same is true of the secondary schools. The college was based upon secondary education as truly in that day as it is now. In my opinion, to use any portion of the money coming from the Federal Government, either through the land-grant act of 1862 or through the appropriation act of 1890, for secondary education, is a misappropriation of Federal money.

Any State that wants to do so may, out of the State treasury, appropriate money for secondary education—that is to say, for the preparatory department of its college of agriculture; but I think that any State which does that commits a blunder. I say this with profound conviction. I want to give a little of my own experience in Missouri. In 1891 there was no standard of admission to any department of the University of Missouri. Any student could get in with an application and a fee. We began to raise the standards of admission to all departments of the university, until to-day there is no department that does not demand for admission a first-class high school education. As we raised the standards of the other departments we at first left the college of agriculture behind. The faculty of the college of agriculture contended that the condition of the rural communities in Missouri would not admit of any standards of admission to that department. But in getting all the other departments to the point where they rested on the high school system I conceived the notion that that department ought to go up too. It had a small attendance; everybody seemed to avoid it who could get into any other department. The men who came and failed to get into other departments dropped into the college of agriculture rather than go home again. It was a catch-all of the other departments, but it did not catch enough to be respectable in numbers. I brought the question before the faculty of agriculture. The whole faculty went against me except one man. After debating the thing an appeal was taken to the board of curators. I wrote to every prominent college of agriculture in the United States, asking what they thought about the propriety of demanding high school education for admission. I was greatly astonished and greatly pleased at the unanimity of the answers, for almost without exception these colleges declared that a good high school education ought to be demanded. I submitted those letters to the board of curators, who, after carefully considering the matter, by a unanimous vote decided that the college of agriculture should be raised to a parity with the other departments of the university and that admission should be based upon a high school education. The next fall the enrollment in the college was far greater than it ever had been before, and it has been growing steadily ever since. In the present year the enrollment in the freshmen class is exactly twice what it was a year ago. When we made the college of agriculture thoroughly respectable in its entrance requirements, men began to come to it, and men are now forsaking other departments to enroll in that of agriculture.

Various devices have been employed for bridging the gap between the elementary schools and the college of agriculture. The most notable of those attempts is the Minnesota experiment. In this case there is between the college and the primary schools an institution at St. Anthony Park, the like of which can not be found on the Western Hemisphere. It is the best secondary school of agriculture I ever saw, and as President Northrup once said of it, "that school of agriculture stands in the minds of our agricultural classes for the whole university and college." That is just my objection to it. It is a screen between the people and the college and university. In spite of Minnesota's magnificent success, I am willing to risk the entire future of the college of agriculture of Missouri on my faith that the Minnesota experiment is not the right way of doing it. Let me say, however, that the Minnesota school is supported out of State funds, and involves no appropriation of Federal funds.

In Wisconsin they have established two schools of agriculture at different points in the State. I believe Wisconsin is going to equip those schools magnificently. If such schools were established in Missouri, all the counties around them would go to the legislature and beg that they be made district agricultural colleges. We in Missouri never intend to have anything between our college and the primary schools duplicating and running opposition to the public high schools of our State; but the college of agriculture, like the other departments, is going to be put in as a part of the public school system. We are striving now, though I can not point to any great results, to put agricultural studies in the public school system, primary and secondary. I believe that if these colleges of agriculture would abolish utterly all their preparatory departments, would begin where the high schools left off, would put on examiners for the secondary schools, would spend money and time and energy on the public school systems of their States, they would finally get their public school systems into desirable harmony with the college of agriculture. In Missouri we are risking our entire future on the doctrine that the college of agriculture is going to rest on the public high schools, and we are going to make the public high school agricultural as far as it ought to be-agricultural. It is the long way, the slow way, the toilsome way, but I believe that it is finally the right way.

L. H. Bailey, of New York. The history of legislation on the subject indicates that in the minds of legislators it is legitimate for the land-grant college to use the funds for elementary instruction and extension work. Whether or not it is wise for us to so use them is quite another question. We have had some discussion in New York State during the past two or three years on the subject of special schools. Three years ago a bill was introduced into the legislature of New York State, which passed both branches of the legislature, allowing the establishment of one school of agriculture and domestic science in every county in New York State, about sixty-one of them. It failed to receive the governor's signature, because it would call for some expenditure of funds from the State department of agriculture. Two years ago the same bill passed the assembly, but it failed in the Senate because the chairman of the committee to which it was referred was opposed to it, and his objection to it was that he did not believe it was wise to duplicate the public school system of New York State by any special system of education. Last year it was proposed to reintroduce this bill, but it was finally decided to let it rest until the college of agriculture matter was settled.

We have at Cornell University a winter course of about 11 weeks. I think this winter we shall have about 200 students; I should like to have 2,000. Yet, I do not believe in the winter course as an integral part of the college or university work.

I have looked upon the winter courses in the university as a temporary expedient, since there are no other institutions that can supply the demand for the kind of instruction that the winter courses give. If there were secondary or intermediate schools that could give this instruction, the demand would not be made upon the colleges and universities. Whether such institutions will ever arise is a question concerning which I scarcely wish to prophesy. If they do not arise, then the colleges and universities must continue to supply the demand for the kind of instruction that is given in the various winter-course enterprises. It is probable that there must always be an adjunct institution to the colleges and universities in which such instruction can be given.

I am in sympathy with the movement for special agricultural high schools. However, I think that the first desideratum is to have the common schools as they now exist open to agriculture on equal terms with other subjects. This will give agriculture opportunity and will not debar it from the privileges of common school development. It will recognize it as a scholarship study, not merely as a technical or occupational subject. Whether the common schools, even when they are open to agricultural work, will satisfy the needs of the rural communities only the future can tell; if they do not, then in the natural course of events special schools will develop here and there to satisfy the demand. I do not like to think of establishing a duplicate system of public schools out-of-hand which would seem to antagonize or at least parallel the existing schools; and it would tend to set agricultural instruction off by itself and to make it only a class subject. Of course there are many difficulties in the way of introducing agriculture into the schools as they now exist, but it is fundamentally correct to open the schools to the subject. Of course the work would need to be elective, at least in most cases. It is always objected that the schools are now full and that a new subject can not be introduced. This of course is temporarily true. The difficulty is that we are trying to introduce the new and modern subjects while at the same time trying to hold to the old curriculum. In time the whole point of view of the common schools will be radically changed and the school will be a natural product of its environment. The very fact that the new and relevant subjects are being introduced is proof enough that this evolution is slowly coming about.

I believe we have the legal right to use the proceeds of the land-grant fund for elementary instruction in agriculture and mechanic arts, but I believe we shall find it wiser policy to utilize State funds and forces already in existence for the purpose of carrying on these educational and extension courses than to use the Federal fund.

The experience of Cornell University is that it is of great advantage to have uniform entrance requirements for all departments of the university, and the attendance of students has increased greatly notwithstanding the strict enforcement of such requirements. Uniform entrance requirements in institutions in which the college of agriculture is combined with the general university is essential to the dignity and success of agricultural work.

E. Davenport, of Illinois. I should very much dislike to hear this discussion closed without some reference to the movement that is on foot all over the country, namely: The consolidation of the primary schools. When you speak of transporting children to central schools, the objection is raised that horses can not travel the roads. Everybody knows, however, that more horses are now used in transporting the children and more miles are traveled than would be necessary to send them all to central schools. It is to be hoped that we will not always have to go on with the little primary schools, four or five children and one teacher.

L. H. Bailey. I think the rural school, as we ordinarily know it to-day, is bound to pass away. It seems to me it is one of the most inefficient units in our body politic. The country mill has passed away. It can not compete with the mills in the city. In the rural school the teacher is teaching her first or second term as a rule, temporarily maintaining herself until she can do something else. The teacher must teach everything, from the alphabet to physiology, from physics to grammar. Our extension work was intended to reach first the country school, but the more we pushed the work the more evident it became that it is very difficult to reach the country school. We think the best that can be done is to introduce the subjects in the village and hamlet schools, and where they have two or three or four or five teachers, so that one teacher can take all of the natural-history subjects and another all of the mathematics, expecting it to work outward from these centers. Centralization is going on in New York State in three or four directions.

A. C. Scott, of Oklahoma. It has been said here that the existing educational provisions of the country community should be exhausted before the college should seek to duplicate any of that instruction. The question naturally arises, What is meant by the educational provisions of the country community? A question of extreme importance in the West is, What shall be done with the young men of 18 or 19 years of age who have gone through the common schools but not through the high schools, and as a matter of fact do not want to go to the high schools? Shall a catch-all be prepared for them? Shall a preparatory department be provided for them where they can say they are going to college? That question gave us a great deal of concern in the Oklahoma college, and three years ago we provided a preparatory department. Two years ago we became ashamed of the department and dropped it, but we substituted a twenty weeks' course in the subject of agriculture. We found that it was very largely the young men and women who went into the preparatory department and did no advanced scientific work in agriculture who went back to the farm. For that reason we established the short courses. It seems to me it will be a very long time before we get agriculture established in the common schools of the country. What are we going to do in the meantime? I believe the present condition ought to be met by some such scheme as I have suggested, or the Minnesota scheme. We are also working in our territory on a scheme by which optional courses shall be given in the high school leading to the university.

R. H. Jesse. I believe that so long as the colleges of agriculture are maintaining their right to use Federal money for secondary education, so long as they are declaring that it is good policy to do so, they will continue their secondary schools, and will not connect with the secondary school systems of their States. For fifty years the University of Missouri maintained a preparatory department. When I came there as president, there were not six good public or private secondary schools in the Commonwealth, and I was assured that they could not be built up. Yet in the space of twelve years we have increased the good high schools in Missouri from 5 to 125. Missouri ought to have at least 250 high schools. But the rate of growth has been magnificent in twelve years. So long as you hold on to this preparatory work and these temporary expedients you are not going to catch hold of the public school system. I think the one vital thing is that the colleges of agriculture, as well as the colleges of liberal arts, should identify themselves absolutely with the public school systems of their States. Meanwhile, I am not disposed to criticise those who employ some temporary expedients, provided they have started in the right direction and are going in that way as fast as they can.

E. A. Bryan, of Washington. One of the most serious difficulties which we face is the fact that under the ideals of the existing four years' high school the student who has taken the eight years of elementary grade and four years of high school is led away from the ideals represented by the land-grant colleges, and in most instances, unless perhaps, as may be true in Missouri, a very strong influence proceeding from the university or from some source secures a different result, he will be led away from the ideals represented by the education for which we stand. That is a fact and condition which we have to face, and is one of the reasonable and legitimate excuses for the maintenance of secondary schools, in which the ideal is not exclusively the old ideal, but which includes something of industrial education. In our own State we have the two institutions, the university and the agricultural college. The requirement for admission to the freshman class in the agricultural college is a high school course or its equivalent, which may be gained in the elementary school. I believe the end is precisely what President Jesse says, but the secondary school must be permeated with the ideal for which the land-grant colleges now stand, and it will be years before we learn not to resort to such expedients as have been mentioned here.

H. C. White, of Georgia. I should like to say that from our experience in Georgia we are able to confirm the theory of President Jesse to the effect that a determination on the part of the college to aid the secondary schools in raising their standards is effective. Of course we suffered, just as you suffer elsewhere in the country, with a lack of studies in the secondary school which are immediately related to the technical courses in agriculture. But in what may be called the fundamental underlying studies, mathematics, for example, English in its grammatic parts, and some language other than English, either classical or modern, we find that by keeping a little ahead of the high schools and encouraging them to raise their curricula we can finally bring the men who pass from the high schools to a very satisfactory state of attainment for entering our college courses. I may be radical, but it seems to me that before a man should enter college it is not so necessary that he should have studied so many things as that he should have studied some things sufficiently thoroughly to have attained the mental maturity which will fit him for the instruction of the college. Now, if we are going to insist that before a man shall enter a course in agriculture he shall have had elementary and secondary instruction in agriculture, it will be a long time before the schools are equipped to meet our requirements. In Georgia we have a four-year course in agriculture, the entrance requirements of the college of agriculture being identical with those of the college of liberal arts. They are not as high as we should like to see them, but they are as high as we think the community will stand; we try to raise it from year to year and bring the schools up to the level. In our school of agriculture, which is one of the departments of the college of agriculture, we have courses in agronomy, in horticulture, and animal husbandry. There is no reason why a young fellow who has been in the common schools, has reached mature years, and has had the proper sort of mental discipline, can not enter these courses.

In high schools they teach a certain amount of chemistry and physics, but the teaching which they get in the high school is not necessarily of the kind that will add to the college course. Seventy-five per cent of those that go to high school never go to college. There is no need for a man in the high school, who is to go to college, to have studied chemistry at all, provided he has studied something else to such a degree and in such manner as will fit him for the work in chemistry when he undertakes it. The same in agriculture and horticulture.

Dean Henry asks: "What are you going to do with those men who are not going to enter the regular college courses?" We say there is a great deal here in these technical courses that is valuable to you. But we are trying to guard against what we consider a fundamental error, namely, to set up such a course by itself and hold it up as the equivalent of a full college course.

K. C. Babcock, of Arizona. We are colleges of mechanic arts as well as of agriculture, and, from my point of view, in Arizona the problem is just as imperative on the side of mechanic arts as it is on that of agrculture. Now, the problem is: Is it legitimate for the Territory that makes high demand upon the college for education in mechanic arts to devote part of its funds to instruction in the elements of mechanic arts? There is not in Arizona, and probably not in the other three Territories, a single institution that gives good secondary manual-training instruction. Yet there is great need of manual training there. The pressure for instruction in the mechanic arts, mining, civil and mechanical engineering, is almost irresistible in Arizona, and we are obliged to prepare for the entrance into the courses in mechanic arts quite as much as for the agricultural courses.

E. Davenport. It seems to be assumed regarding instruction in agriculture that it is a four-year course or a two-year course or a short course or nothing. In my opinion the unit is too large. The farm boy wants instruction in a particular subject; he is not thinking much about graduating, and when you meet him at the door the first day with the proposition that he must choose either a four-year course or two-year course or short course he is likely to take the line of least resistance. A large proportion of the work of our universities and colleges has to do primarily with students who do not graduate. For every student who graduates about three or four do not. The influence of the college and university system of this country is not exerted solely through its graduates. It is through the great mass of students, many of whom do not complete the regular courses. Let us stop talking about four-year courses, therefore, and fix the eye on the student. Let him take one or two or three years. Let him get those things he wants, without regard to whether he graduates or not.

Now, there is much elementary instruction in hitching up the team, in plowing the field and getting in the crop, in feeding the pigs and getting the steers to market, and the average student of 18 coming to us from the farm is often better prepared for college than the average high school graduate. It is an obligation of these colleges to make a system of secondary education for the country people. In Illinois we simply cut across all precedent and all lines of responsibility by saying to the boys on the farm, "Come to the university and choose the subjects you wish to study. These are the things we undertake to teach in agriculture, about 80 of them; if you want any of them, go ahead. If you can not do business here you will go home. But if you take those subjects you must take certain other subjects with them, and one of them is English. And if you stay long you will take some science, because certain subjects require science." Three-fourths of the boys that come from the farm have not had much education, but they do well in the sciences. We had 20 students six years ago, and now we have 340, taken just as they come. One-half of the work they do is done in other departments of the university than that of agriculture—civil engineering, English language, botany, history, chemistry, Greek and Latin, if they want it—and the percentage of failure on the part of our students is below the average of the university; the percentage of graduation as high. The situation is much the same in all institutions. Three-fourths of the students in all lines never graduate.

We have a splendid preparation of a scholastic order for the city people, but we have no such preparation for the country people. Let us have a little better preparatory course for the farmer, and stop talking about four-year courses and about conditions for admissions, but bring the student to the college and let him take up at once the subject he wishes to study. We are setting up too high a standard for agricultural courses when we demand that if students will not take the four-year course therefore they must take something peculiar and inferior. If you confront them with such conditions you will drive them out of the agricultural courses. It is not done in other lines; why do it in agriculture? Identify the boy with his subject. We have seniors, juniors, sophomores, freshmen, specials, all together in the same class. You may protest against that, but bear in mind these boys are studying Shorthorn cattle or some other technical subject. The special student has a herd of Shorthorn cattle at home, perhaps, and he is as able to study Shorthorns as the senior, and sometimes better. They can meet on a common ground in the class room. Give them a chance at election; do not drive them into something they know nothing about. If a student comes to us at 18 years of age and is deficient in English, i. e., has less than 42 credits, or three and one-half years of high school work, he must go to the preparatory school and take English. He may choose his other subjects. If he is 16 years old he must spend half his time in the preparatory school, and the other half may be given to other subjects, allowing him to elect any subjects he is able to carry. The fact is we have very few students under 18. Most of our students are 18 or over. A great many of them are between 18 and 21. At about 17 or 18 or 19 boys begin to think they are too old to go to high school, and if you do not let them into the college you will never get them. If the boy is 18 years old we shut our eyes to all deficiencies except English.

He can graduate here without mathematics, but he must take two years of foreign language, because the foreign language, we think, is nearer to agriculture than is mathematics. If we had a department of agricultural economics—which we hope to have—the student in that course would be required to have mathematics, or if he elects subjects requiring mathematics he must take mathematics now.

A. Scott, of New Jersey. I sincerely hope that it will not go down on the records that the assumption that Professor Davenport has made is generally true. That all our institutions are like his in all particulars, excellent and otherwise, will not be accepted as the consensus of this body, because I am quite sure that some things he has said of his institution are not true of mine. We require of every boy who comes to college that he shall know algebra, plane geometry, and solid geometry at least, and must pass examination in these subjects. I should not like to have it said that three-fourths of those who go to our college are not graduated, for it is not true. More than half are graduated, although many fall by the way for one reason or another. This is a local issue. It is becoming more and more apparent every year that we must recognize that differences of conditions that are fundamental have to be taken into account. These are schools of agriculture, and, as my friend from Arizona has said, of mechanic arts. They were founded for training in the sciences applied to industrial pursuits, for the poor boy of the city as well as for the poor boy of the farm. We recognize in New Jersey the importance of agriculture. It is second to none, but there are others that should stand on a parity with it. We have laid great stress on agriculture. In New Jersey, for example, there is a vast field for the civil engineer and the mechanical engineer, and we must make adequate provision for instruction in these and similar lines.

This is, moreover, a matter of mental training rather than of special subjects. What we want of the boy is power, not special training.

W. O. Thompson. To recur to the original paper that brought out this discussion, the question first was the legal right to teach the elements of this subject. I hope the paper made it clear that the elementary teaching was not confined to schools below the college, but that in our colleges there was elementary instruction in many subjects, and that the definition in the statute or elsewhere could not limit the instruction, if it insisted on subjects rather than method. I think we also realize from the discussion that we are confronted with a condition to which these colleges must address themselves. There has been agreement that we are all trying to meet that condition, and there has been some disagreement as to how it should be met. I may be permitted to say that in the institution which I serve the entrance requirements are rigidly enforced. I do not want the impression to be left in this meeting that any institution in this circle of colleges has fallen to the low depth of its privileges under the law, but that all are trying to rise to the highest of their privileges under the statute. I think no one of us would ever regard it as possible for us to be content with the perpetual condition of doing what we do not desire to do but what we think ought to be done as a temporary measure. It may be that for five years or it may be that for five hundred years there will be a large class of young men who may be interested in agriculture by one method that never would be interested in it by another method however perfect theoretically. So far as pedagogical theory of instruction in agriculture is concerned, I think these colleges must meet the conditions, but I think none of them should make an apology for a low standard of entrance.

On motion, the section adjourned until 2 p. m. next day.

Afternoon Session, Wednesday, November 2, 1904.

The section was called to order at 2 p. m. by Chairman W. E. Stone.

Military Instruction.

The following paper by M. H. Buckham, of Vermont, on "The intent and purpose of the Morrill Act with regard to military instruction," was read by G. E. Fellows, of Maine, in the absence of the author:

The bill for the endowment of colleges of agriculture and the mechanic arts, which passed both Houses in April, 1858, and was vetoed by President Buchanan, did not contain the provision for instruction in military tactics incorporated into the later bill. In a speech by Mr. Morrill on April 20, 1858, setting forth at great length the objects and provisions of this first bill, no allusion was made to military instruction, nor was there any reference to it in the course of the debate. The bill to which the present colleges owe their existence was introduced, debated, and passed in the summer of 1862, and bears the significant date July 2, 1862, the day following the last of the seven days of McClellan's Peninsular campaign. In the course of a speech in the House explaining and advocating the measure, Mr. Morrill put considerable emphasis on the military feature of the education provided for. I quote passages from different parts of his speech:

"If this measure had been instituted a quarter of a century ago, the absence of all military schooling at the outset of the present rebellion would have been less deplorable in the Northern States. The young men might have had more of fitness for their sphere of duties, whether on the farm, in the workshop, or on the battlefield. * * *

"Something of military instruction has been incorporated in the bill in consequence of the new conviction of its necessity forced upon the attention of the loyal States by the history of the past year. A total unpreparedness presents too many temptations, even to a foe otherwise weak. The national school at West Point may suffice for the Regular Army in ordinary years of peace, but it is wholly inadequate when a large army is to be suddenly put into service. If we ever expect to reduce the Army to its old dimension and again rely on the volunteer system for defense, each State must have the means within itself to organize and officer its own force. With such a system as that here offered—nurseries in every State—a sufficient force would at all times be ready to support the cause of the nation and secure that wholesome respect which belongs to a people whose power is always equal to its pretensions. In a free government we have proved, notwithstanding some 'in time of temptation fall away,' that patriotism is spontaneous, but doubtless many valuable lives would have been saved in the progress of this plague-spotted rebellion had we not so long assumed that military discipline was also spontaneous. If ever again our legions are summoned to the field, let us show that we are not wholly unprepared. These colleges founded in every State will * * * to some extent guard against the sheer ignorance of all military art which shrouded the country, and especially the North, at the time when the tocsin of war sounded at Fort Sumter."

These words clearly explain the object which Mr. Morrill had in view in making provision for instruction in military tactics in the colleges of agriculture and the mechanic arts.

The presence of a great conflict, which found the nation unprepared to meet either internal or external enemies, awakened public opinion to a sense of danger—a danger not only in the past, but ever present; a danger which could not be met by an extemporized army, or a levy en masse, but only by a provision which should be of the nature of an institution, not subject to temporary change of feeling, not liable to failure from neglect or forgetfulness. To statesmen looking beyond existing tumults the Republic meant peace, but they were then for the first time learning that peace exists only in those nations that know how to maintain peace. To keep up a large standing army was contrary to the genius of American liberty and to all national traditions. But here was an opportunity to do something toward meeting this ever-present danger of "unpreparedness" by distributing throughout peace-loving and industrial communities in every State a certain amount of "military schooling," as Mr. Morrill calls it, and the result of such schooling in a goodly number of men, highly trained in other respects, with a modicum, more or less, as the plan should work out, of military training superadded.

It may be pertinent to note that, when, twenty-eight years after the passage of the bill, in the "piping times of peace," Mr. Morrill again asked Congress to consider the needs and claims of the education offered in the colleges of agriculture and the mechanic arts and to increase their scope and their efficiency by an increased endowment, no further provision was made for, and no mention was made of, military instruction.

Passing now from consideration of the motives and utterances of the founder of the colleges to the language of the organic act, we find that the intent and purpose of the act as regards military instruction gets rather scant expression. It is all embraced in three words—"including military tactics"—"one college where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach, etc." That constitutes the entire mandate on the subject. It is evident that the intent of the act was not to establish military institutions—that is, institutions in which the leading object is to teach the military art. Classical and other scientific studies are not to be excluded, and military tactics are to be included, but the leading object is to teach branches of learning related to agriculture and the mechanic arts. Evidently there were not to be military academies after the manner of West Point in all the States, nor feeble imitations of West Point.

If some institutions or some army officers detailed as military instructors in the colleges have desired to make the military the leading feature, to insist on army ideas and methods in the government of the institutions, and to subordinate practically the other elements to the military, this has been without warrant from the ordaining act. If this had been the intent and purpose of the founder and of the act of Congress, they would have declared military training to be the leading object, whereas it is not included among the leading objects.

What is meant by the term "military tactics," which the act says are to be included in the branches taught in the colleges? Obviously the word "tactics" is used in a general and popular, not in a technical sense. "Military tactics" is a broad and elastic term, including much that would not come within a strict definition. This breadth and comprehensiveness, in distinction from a rigid prescription of specific things to be done, is characteristic of the whole act. It recognizes the great diversity of conditions existing in different parts of the country, and now that it is operative in forty-five different States, this elasticity and adaptability to conditions appears still more admirable. It is matter for congratulation that we have in this grand scheme for national education, not a thoroughly organized, bureaucratic system like that which fits in well with the genius of the French people, but a simple outline, a broad, free, suggestive sketch plan, of the general objects to be sought, leaving to the several localities, and specifically to the legislatures of the several States, to fill in the details as their special needs and interests may prescribe. As in the case of all other branches of learning, so in case of the military science and art, the institutions are left free to work out their own problems in their own way, provided that way comes fairly within the express provisions of the act of Congress. As we have seen, the incorporation of military instruction into the curriculum of the colleges was intended to meet one of the great and permanent needs of the country. Such instruction is mandatory upon the colleges. By the acceptance of the grant with its conditions this instruction has become an obligation, recognized as such by the colleges. So much—that the colleges shall give instruction in military tactics—is, so to speak, constitutional, unalterable, not debatable. All else is merely statutory or administrative, subject to by-laws, as wisdom and good policy may ordain.

Leaving, therefore, large latitude to the predilections of individual institutions for more or less of the military feature in their curriculum, what may the colleges, in an average way, be fairly expected to do as their part toward supplying the country with a soldiery in time of need? The organization of a national militia under Federal laws in all the States has materially changed the situation since Mr. Morrill pictured the nation's "unpreparedness" in 1862. When not recognized as a part of the militia—as they are in some States—the college battalions represent the possibility of a volunteer corps which would be immediately effective for service, and the individual students and graduates constitute a body out of which officers, commissioned and noncommissioned, could be drawn for service in a suddenly enlisted corps. It can not be expected of the colleges that they turn out thoroughly trained and accomplished officers. It takes four years of military training at West Point to do that. To attempt even something very much below this would take so much of the students' time and energy from their main studies that they would go to colleges in which this burden was not laid upon them. But the colleges, without sacrifice to their "leading objects," may so train their students in the military art, that they, or a good number of them, would make serviceable sergeants, lieutenants, and captains in any force which the State or the nation might need for keeping the peace and enforcing the laws. It is of some consequence that students should make a good appearance at inspection or on parade. It is of much more importance that they should learn some of the soldierly virtues, prompt obedience, power of command, the fine combination of self-respect and submission, which make the good citizen and the good patriot as well as the good soldier.

But on this part of the subject I am privileged to offer the expert evidence of an able and accomplished officer of the Artillery Corps and a highly successful professor of military science and tactics in the University of Vermont, Capt. C. J. Bailey, Fifteenth Artillery. Captain Bailey says:

"An opinion is desired as to what extent military instruction should be carried in the land-grant colleges.

"Throwing out those institutions in which the military feature predominates and is advanced as an attraction for students, there remain the colleges or universities in which the student is fitted for almost any profession save the military. In these every hour devoted to military work takes from the student an hour he might advantageously devote to studies in the particular line he has chosen. Should, then, this military work be limited to three hours weekly, and is even this worth to the student and to the college the advantages gained by both from the endowments made by the Government?

"When the writer took up this work in the University of Vermont in 1897 he was of the opinion that the three hours weekly was inadequate for carrying out the purposes desired by the Government and he still believes that it should be increased, at least during that part of the college year when outdoor work can be carried on, if this can be done without positive detriment to the other work of the college. If this can not be done, however, sufficient instruction can be done in the shorter time to render its value incontestable, particularly if the instructor is allowed some latitude in dividing the students in such a way that small bodies can be instructed in certain parts of the work rather than the whole student body at once.

"In colleges keeping to this minimum much that an officer deems essential in teaching recruits must either be omitted or the student so interested that he will voluntarily do the work by himself. This refers particularly to the 'setting up' drills and calisthenics now so largely employed in the Army. The college gymnasium may and should take the place of these, for it is particularly necessary that the student should have them or similar work both to keep him in health and to give him the erect carriage distinctive of the good soldier and equally advantageous to the good civilian. But the writer realized from his first attempt that to make any progress in the drills of the company and battalion nothing beyond a superficial course in these gymnastics could be attempted.

"Both theoretical and practical military work can be so varied that the interest of the majority of the students is easily retained, the difficulty being to decide on what to omit where time is so limited. Many students find the whole subject uninteresting and even distasteful, and these are the ones to whom much attention should be given, for they are generally the ones most in need of the physical exercise—for their own health. The athletic men are generally the best soldiers and take the most interest in lectures and recitations as well as in the drills.

"That the work so outlined is of value to the Government can not now be questioned. The many valuable officers now in the Army whose only military training was obtained in the land-grant colleges bear testimony to this.

"Earnest and faithful work on the part of the instructor, with the cooperation and support of the faculty, aided by the natural liking of many students for the military, can not fail to render the course successful and give the Government a fair interest on its investment—even with but three hours weekly for each student. The more this time can be increased the better for the Government and, in the opinion of the writer, for the physical and mental welfare of the student and the ultimate good of the college."

Coming now to the second part of the question proposed, namely, the relation of the colleges to the War Department, there are two attitudes which the Department may take with reference to military instruction in the colleges. The one view is that the Government has bestowed large endowments on these colleges, and has a right to demand in return special military service which men educated in these colleges can render, and to prescribe the methods of the training which fits them for that service. To this view no objection can be taken if it is not in practice carried so far as to exact of the students an amount of effort which would impair their efficiency in their chosen field of study, and so drive them into other institutions and thus defeat its own intent. It is natural also and honorable in the military authorities at Washington that they should seek to prescribe a standard of instruction and discipline which bears some comparison with that splendid training at West Point which gives dignity and prestige to an officer in the Army of the United States, or at least that their point of view and their estimate of military education should be largely under such influence. Then there arises a difference of judgment between the Department and the colleges as to how much may be insisted on in the way of military discipline, in which we find the Department virtually saying to us, with military courtesy, but with military firmness: "We will not detail an army officer to conduct your military instruction unless we can dictate substantially the amount, the methods, and all the conditions of such instruction."

The other view which the Government might take is not to insist on military training as an obligation on the part of the colleges and the detail of an officer as a concession carrying with it a certain supervisory right over the colleges, but to look at the whole situation as an opportunity of which both parties should strive to make the utmost for the good of the country at large.

Here is a body consisting of many thousands of the choice young men of all the States of the Union, as good material as the country or the world affords for making citizen soldiers—such soldiers as the country is likely to need—and at an expense to the Government which is trifling compared with what any other method of getting such soldiers would cost. There is a certain amount of the military spirit—call it the patriot-military spirit—which it is desirable to cultivate in our youth—not too much, not the militarism of France and Germany—not too little, not the supineness and neglect, inviting assault, of the North before the war—but enough to inspire a sense of security and compel respect. Let the Government take advantage of the opportunity it has to get this moderate amount of military spirit diffused among the young men of the nation and, along with it, the moderate amount of military training which will make it practically effective in time of need. This it will best accomplish, not by setting up a military régime of its own within a literary institution, not by issuing orders from Washington which ignore or override the policy and the regulations of the colleges, but by cooperating with the institutions in a patriotic endeavor to make such adjustment of the legitimate claims of the civil and military departments, respectively, that all shall attain their maximum efficiency. Passing over some of the obvious considerations under this head, we may be permitted respectfully to suggest for the consideration of the Department:

(1) That less emphasis be placed on the manual and technical branches of military training, and more upon the higher, the intellectual, topics in the military art. College students take "military tactics" as part of a liberal education, not to fit them to serve as enlisted men. Introducing a cerain amount of

strategy, the history of campaigns, fortification, problems in "grand tactics," etc., would bring the instruction more within the range of college studies.

(2) The inspectors sent to examine and report on the condition of the military departments in colleges should be experienced, broad-minded men, capable of understanding the situation in its larger meaning and possibilities. Some of the institutions have had occasion to complain that young officers, from inability to appreciate the difference between a literary and a strictly military institution, have done them great injustice by setting up an impossible standard of efficiency and severely commenting on alleged delinquencies. The inspector, especially if continued in office long enough to learn its possibilities, can, by conferring and cooperating with the college authorities, by instruction and advice to the cadet officers, and in many other ways, easily double the efficiency of the military instruction. The institution represented by the writer of this paper enjoyed all these benefits and others under the inspectorship of Col. (now Gen.) R. P. Hughes, U. S. Army. A well-trained officer, a strict disciplinarian, and a thoroughly soldierly man, he interested himself to bring the college battalion up to the highest state of efficiency and to promote the true military spirit among the young men of the institution. In doing this he gathered to meet him the officers of the battalion, lectured them, scolded them, praised them, instructed them, and so discharged the duties of his office in a way at once professional and human that his visits were looked forward to with interest and remembered with pleasure, and though his reports sometimes scored us severely we knew that they were just and kindly. If the Government would always send out inspectors equally faithful to the War Department and equally helpful to the institutions, there would be little cause for complaint on either side and the problem of efficient military training in the colleges would be in a fair way of satisfactory solution.

E. R. Nichols, of Kansas. I am very much in favor of military drill from every standpoint, and I believe it is fortunate that it is a part of the endowment of these colleges. It seems to me the management of this military matter is largely a local affair. I have reference now as to whether it shall be one day or two days or five days a week, and whether it shall be one, two, three, or four years, whether it shall be in the fall or spring terms or how it shall be. In our college we would as soon have drill four days in the week as two, but we would dislike to have it five days. It is desirable to have one afternoon off in which students can have their literary and athletic exercises and things of that nature. It is desirable that we have drill four days and not five days. I would propose as a possible solution of this question that we ask the War Department to state the maximum number of hours that will be satisfactory to them for practice, for theory, and for the ceremonials, leaving each college to apportion the time through the week as best meets their conditions. We have tried various ways of meeting the present requirements without success at the Kansas Agricultural College. I believe, however, if we would ask the War Department to fix the number of hours for practice and theory and the ceremonials that we can adjust ourselves to the condition unless it is made very difficult.

C. C. Thach, of Alabama. There are some points that have been covered in the paper by President Buckham and in the comments by President Nichols that I think should be emphasized. We have had experience in military instruction in our institution in Alabama since its inception about thirty years ago, and we stand, I think, somewhat on the middle ground in that respect. I agree with President Nichols that this is a local question very largely, and the conditions vary widely in different institutions. It should be left in all its details and minutiæ to the boards of control of the several institutions. In our institution we have a quasi military organization, but much attention has from the first been given to military training.

The act of 1862 explicitly requires such training, and I do not believe that we can comply with the spirit or the letter of the law without having military instruction of a very definite and fixed amount and nature. Our experience bears out the statement by President Buckham that the United States Government has been greatly strenghened by the success in military instruction of these land-grant colleges.

We should not lose sight of its value as an educative force, particularly in a military way and in patriotism, but another advantage is the physical training it gives. I believe it is worth while to have it for that reason. I am a great believer in all forms of athletics, but only a small percentage of the student body actually participates in athletics or even work in the gymnasium. President Eliot, of Harvard, found that out of about 3,000 students only about one-third took active part in athletics. Military instruction furnishes a readily available means of giving all the students the physical training they need. It furnishes exercise, not simply as a gymnastic, but exercise with the ulterior purpose of training the men for something definite. We must not minimize the military feature. I believe it is a question of education, not only in preparing a man for military service and in inculcating patriotism, but I believe the training is in itself educative.

As regards the practical application of this matter, I think you will have as many views as you have States. I believe the question ought to be approached in a conciliatory manner. Military men are easily antagonized. They want men to obey whether or not. Therefore I do not believe in the extreme military feature. But we can approach the question in an amicable spirit. I do not believe, however, that the suggestion of the minimum amount of hours will meet the situation. I think two hours is too small. We have three now. We used to have five, and that was undesirable, but we get along very well with three. We haven't had an army officer in six years, but during that time we have made our quarterly report, and we get our arms. If five hours' drill are to be required we are not in a hurry to get under the Government. We now have in charge a man of our own training, who knows the situation and is willing to adapt himself to conditions. We have two general roll calls a day and three drills. The seniors have power to report offenses of various kinds. We do not find that power abused. We excuse our athletic teams, but it does not preclude them from promotion as cadet officers. Some of our best cadet officers are from the athletic team.

E. A. Bryan, of Washington. For a thousand years or more we and our ancestors have believed in the citizen soldiery. We have proceeded on the theory that our national defense is to be intrusted chiefly to the citizen soldier. Along about the time of the civil war we woke up to the fact that the National Guard, which had been intrusted in a measure with the training of the citizen soldier for times of defense, was a poor reliance; that it was not in shape to serve the purposes of national defense, and I have no doubt, as has already been intimated, that it was due to the condition we then faced that the military clause was inserted in the first Morrill Act. I remember hearing a volunteer officer in the civil war say that in his entire regiment at the outbreak of the civil war there was not a single man that could drill a squad. I have no doubt that the statesmen of that day and citizens of that day felt very keenly the fact that there were few intelligent and educated men who had any knowledge of military science and tactics, and that it was due to this that at that time a new theory was injected into our system of national military education. As a result of that we have to-day three general plans of military education: First, that which is typified by West Point, a distinctly military school for the training of military officers; second, the National Guard, where for a few days each year the citizens who volunteer in the companies are trained, and third, the students who are trained in the land-grant colleges in this way. I approve this as a national movement, as a great means of national defense. I believe we should have a general system which will provide men of intelligence and education, who can in time of war or stress be called upon for service of this kind, and I wish to point out to you the fact that since 1862 there has been an entire revolution in our system of national militia. At that time it was wholly and totally inefficient; to-day we have a very efficient National Guard. If we were able to inquire in detail into the facts, I believe we would ascertain that the introduction of military instruction into the land-grant colleges is chiefly responsible for that result. This fact became quite apparent particularly at the time of our late war with Spain. Many commissions were issued in the United States Army at that time to persons who had had their training in these institutions. So that not only through the direct participation in military affairs by the students who had been graduated at these institutions, but by their participation in the legislatures of the States, and by their influence in molding public sentiment throughout the States, they have aided in establishing a system of national defense far superior to that of forty years ago. Notwithstanding that fact there are many things in our system that need amendment, and it is possible for this association to do much that would lead to a better state of affairs. I would call attention to the fact that while for forty-two years we have had this law upon our statute books, there has been very little done by the Government to provide for adequate instruction within the colleges. We have been supplied with a portion of the equipment necessary—guns and ammunition chiefly. There are many things needed for proper instruction which are not supplied. While the National Guard, drilling less than one-twentieth of the time that the students do in our colleges, are supplied with uniforms, the students of the several colleges are not supplied with uniforms. I believe this association should urge upon the War Department the more adequate equipment of the military departments of the several institutions. While I have this high appreciation of the value to our nation of this instruction, and while I believe it would be possible and very desirable indeed to be better equipped for it, yet I certainly feel that the present attitude of the War Department is by no means a fortunate one. You will remember that for many years the officer who was detailed as commandant in any institution was directed to report to the president of that institution for orders, and that the War Department did not give direct orders to the commandant. I think you are also aware of the fact that to all intents and purposes they now ignore the institution and its officials and give direct orders to the officers of the Department as to their duties. I think you will all concede that it is utterly impossible to administer any institution properly where some other authority may come in and direct or modify or control by order the programme of work. I quite sympathize with the suggestion which has been made that steps should be taken, perhaps through the Secretary of War or by calling the attention of the President of the United States to the question, to improve the present situation. It seems to me the time is ripe for doing something in this direction, and I believe it will not be to the injury, but to the benefit, of the great system of national military education.

I believe this association should also solicit or attempt to secure some further recognition of the work done by the land-grant colleges in the direction of the military instruction. Lately we saw with approval an order for the appointment to commissions certain graduates of schools where military instruction is given. Of the six schools chosen last spring I think not one was a land-grant college; all were private military schools where young boys attend and where the leading feature is military drill. It is true that the older, more experienced men in the land-grant colleges have perhaps not given so much time and attention to military drill as the younger boys in certain military schools which make their military departments a specially attractive and prominent feature, but the late war with Spain shows that those officers who came from the land-grant colleges served with distinction and with credit. I believe that the best results that we can hope to obtain will be by the recognition of these institutions as an integral part of our system of military education and a proper source from which upon occasion the officers of the United States Army may be recruited.

C. R. Van Hise, of Wisconsin. The question for us is, What is the minimum to which we can all accede? The irreducible minimum of two hours per week incorporated in the resolutions offered in general session this morning (see p. 63) was selected because this is the amount which is the practice of various large institutions at the present time. We in Wisconsin have two hours per week, and we hold that to be a full and fair compliance with the Morrill Act. We require also two hours of athletic work two days per week in the gymnasium, so students get the setting-up exercises and development work which in other institutions is done in the military department. The resolution does not say that the officers shall not give more than two hours per week during two years. Indeed, at the University of Wisconsin and at other institutions, all officers are selected from the junior and senior classes and are required to give two hours additional work during three or four years in order to make effective their work as drill officers.

I am sure the resolution expresses the view of a large number of colleges as to the irreducible minimum. I feel that if the association will unite we can get the Secretary of War to give a decision on this point.

Mr. Thach. It seems to me that taking action as to an irreducible minimum of two hours a week rather puts the colleges that require three or five hours in an improper position with their student bodies.

Mr. Van Hise. Not at all. If a college does not require much gymnastic work it is proper to require more military work. In Wisconsin we used to require four hours a week in military in the freshman and sophomore classes, but when we got a large body of men we believed it proper to give half the time to military work and half to athletic work.

A. Scott, of New Jersey. The original Morrill Act intended that the legislatures of the States should prescribe the curriculum, only conforming to the general statement of the law. The State legislatures have very properly given the matter into the hands of the trustees, and the trustees have intrusted it to the faculty. There is in theory a perfect system of national and local control. I am not behind any of those who have spoken in giving tribute to the excellencies of this form of education up to a certain point, but by virtue of the Morrill Act we are not constituted a set of military colleges, and I think this association should insist upon its right to control the military instruction provided for in the organic law of the land-grant institutions.

R. W. Stimson, of Connecticut. It seems to me that the relation of the land-grant college to the War Department is one purely of a bargain, and I think the War Department is at perfect liberty to state terms, provided it states them explicitly and does not mislead. If the War Department says, "If you want so much equipment gratis; if you want a military officer gratis, and are willing to give five hours' instruction a week on specific subjects, we will close the bargain with you," it seems to me that is perfectly legitimate, right, and proper.

L. H. Bailey, of New York. It is competent for any of these land-grant colleges to have its own officers in military instruction. Is not this the solution of the matter? In that case we have no favors to ask.

E. A. Burnett, of Nebraska. The conditions have become so difficult in our institution that unless some modification can be made within a year or two there is no question that the regents will find it necessary to permit the War

Department to withdraw its detail and its equipment, if need be, and proceed with our military instruction under such conditions as we may be able to afford. This is a matter of much regret to the chancellor, because he believes in military instruction.

W. O. Thompson, of Ohio. The section of the first Morrill Act which relates to military instruction is as follows:

> The President may, upon the application of any established military institute, seminary or academy, college or university, within the United States, having capacity to educate at the same time not less than 150 male students, detail an officer of the Army or Navy to act as superintendent.

I call attention to the wording of the statute in order to show that it is not mandatory, but permissive. Under this statute the President may detail, or he may decline to detail. In time of war, when the officers are in demand, he may refuse a detail, and during the Spanish war he did not detail anybody except retired officers. But since that war there have been some detailed who are not retired officers. There is not a college in this whole association that can meet this Order No. 65 with five hours a week. If they could do so they would, and say no more about it. Some of them now give four hours of drill and an hour's instruction in addition, but they can not give more than that without seriously interrupting the work of the college. The mandatory character of this order has raised the question as to whether we can obey it. Our commandant says we can not do it. If we have entered into an agreement, as suggested by President Stimson and Dean Bailey, we can close the contract or decline to renew it. I think it altogether likely the Ohio State University will request the Department to cut off the detail of its officer, and then will make some arrangement of its own. I do not see any other way out of the difficulty.

I shall not object to a minimum of two hours, but I fear that if we make the minimum so low as two hours it will simply irritate the army officers.

It seems to me that the method of attack of this association, if an attack is to be made, is to go by competent committee on which I should have some recognized military man, to the President of the United States and state our difficulties, and ask his advice. I would refer this resolution to our executive committee for consideration with a view to devising some means of reaching the matter through the President, giving them full power to act, knowing very well what the state of sentiment is in this body.

J. K. Patterson, of Kentucky. About eighteen years ago in the preliminary meeting that was held in Washington to take steps looking toward the organization of this association, this question came up and was debated with a great deal of earnestness, I may say with not a little acrimony. There were a few of the colleges represented on that occasion who were quite willing, and I may say anxious to comply with what they believed was the spirit and intent of the organic law as set forth in the act of 1862. They held that there were two or three things that were made obligatory in that organic law. One was, teaching those branches of learning relating to agriculture, and another those relating to mechanic arts, and another relating to military tactics. There were certain subjects that were optional, that might be included or might not, and these were classics and other scientific studies. They held that if it was obligatory upon the colleges to teach sciences relating to agriculture and to mechanic arts, it was equally obligatory to make provision for carrying out what they believed to be the intent as well as the letter of the law in regard to the instruction in military tactics; that they could not set aside the one without setting aside the other; that there was no more reason why they should adhere to military tactics and mechanic arts and eliminate agriculture than there was to adhere to agriculture and mechanic arts, and eliminate or perform in a perfunctory way military tactics. I remember that those who held these views were in a small minority. Some were willing to abolish military tactics in the colleges at that time altogether, and to brave the consequences, whatever they might be. Others wished to reduce it to a very small minimum; I was among those who proposed to carry out in good faith what they conceived to be the obligations of the act. From the beginning of my administration of affairs in the college of agriculture and mechanic arts in Kentucky, in 1869, to the present, I have endeavored to carry out the act of 1862 in its fullness and totality. We have had no difficulty with the War Department, and have encountered no difficulty in carrying out Order No. 65. Until about three years ago we required all male students to drill throughout all classes and allowed no exceptions or evasions. Now the senior class is exempted from military service.

As a matter of interpretation of the law, I think this matter ought to be regulated by the State to which the grant is given, but no specific action has ever been taken with reference to this burning and vexed question that has tormented us for years. If any legislature would take the initiative in defining what it conceived to be the duties of the colleges organized and controlled by it under the organic law of Congress, or say what they wanted done, it would bring a direct issue between the legislature and the War Department of the United States, but I do not consider it wise to do this. In my opinion the present crisis is very largely our own fault. All of us who have attended these meetings for the last fifteen or twenty years know that there have been a number of colleges represented in this organization that have always stood for military tactics and military drill. There have been a number that have constantly been endeavoring to avoid and minimize it, and some would have been glad to eliminate it altogether. For a number of years an inspector did not come around at all, but within the last ten or fifteen years the inspector sent by the War Department has come around annually. He visits the commandant, and the president and some of the cadet officers, and he makes up his report from what he hears. It is on account of the unfavorable character of some of these reports that Order No. 65 has been issued by the War Department.

Mr. THOMPSON. How many hours a week do you give to this matter?

Mr. PATTERSON. Five hours a week.

Mr. THOMPSON. We are giving four hours a week to drill plus one hour of instruction, and we have been censured. Our commandant says we can not carry out Order No. 65 with ten hours a week.

Mr. PATTERSON. When Order No. 65 came I had a conference with the commandant, and I said, "It matters not whether it subjects us to any inconvenience in other directions or not, you must carry out loyally the spirit of this order and its intent, and if five hours is not sufficient, you will have to take a sufficient amount of additional time from other duties connected with the college." The military instruction is a popular feature in our institution.

We were fortunate enough to have upon our first board of trustees a major-general of volunteers, who drew up the regulations for West Point fifty years ago, and he impressed the military spirit and the spirit of the military organization upon the State college of Kentucky, and it has never sought to escape from it. From another point of view I conceive that military instruction is one of the best features of these land-grant colleges. As stated by President Bryan, we raise our armies not by conscription, but from the volunteers. Now, in the event of a great national crisis, and in view of our great national expansion, we must provide and educate citizen soldiery that is capable of meeting emergencies when they arise. Military training will always be popular in this country, because we are potentially a military nation, and will have to provide the military education by which a citizen soldiery will always be at the command of the United States of America. One of the features of this training is the habit of obedience, which it inculcates. I submit to every one of you gentlemen here that obedience to law and wholesome submission to salutary restraint is one of the great desiderata in the education of the young men of America. We are inclined to be somewhat lawless—we have the reputation of being lawless. In looking over the penal statistics of Great Britain, of the United States, Germany, and France, you will find that, unhappily, we are very largely in the ascendant with the percentage of crimes, the percentage of murder, the percentage of deeds of violence to which the habit of disobedience necessarily leads, as compared with any other civilized countries of the world. But we can make this military education in these several institutions auxiliary to the improvement in this respect, and, it seems to me, it would be well worth the expenditure of our time and worthy of our consideration and efforts.

After some further discussion President Van Hise's resolution was adopted in modified form, as already given (p. 63).

WHAT DEGREES SHOULD BE GIVEN FOR THE COMPLETION OF UNDERGRADUATE COURSES IN LAND-GRANT COLLEGES?

G. A. Harter, of Delaware, presented the following paper on this subject:

The subject that has been assigned me by the programme committee to-day gives me peculiar satisfaction in that I shall be able to present my personal views instead of being required officially to announce a distasteful practice, as I must do in college publications and at college functions.

"What degree shall be given for completion of undergraduate work in land-grant colleges?" has been asked by each of these institutions and has brought forth a great variety of answers. When these colleges were first organized there was no uniformity of conception among educators as to the work that they were meant to perform in the national educational economy. Provision was made in the law approved by President Lincoln, July 5, 1862, for "the maintenance of at least one college in each State where the leading objects shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may, respectively, prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." This was a time when the old forms of education were found to be inadequate for the training of men for the several pursuits of life, and new methods and new schools, wider in every sense than the old classical college, were springing up. The old college, with its Greek, Latin, mathematics, and modicum of science no longer filled the want of those who sought an education to train them to do things in the affairs of the world.

The college was no longer looked upon as the place where boys should go to get preparation for entering the so-called "learned professions" only, but young men began to find that they could be fitted for other occupations that demanded as serious application of mental powers as were used by the preacher, the lawyer, or the doctor. The Morrill law of 1862 was but an expression of the great popular dissatisfaction with the old-fashioned college curriculum. It was an attempt to adjust the new education, as it was at that time understood, to meet the new requirements of the sciences in the college course to the training of the industrial classes.

The historian of the future will point with pride to the sympathy of the United States Government with this great popular demand for widening and deepening in every way the channels through which the various organized agencies of educational processes have laid hold of American life.

Soon after the passage of the land-scrip bill, colleges were organized in every State, beneficiary of the provisions thus made for them. In some States they were established in connection with colleges already in existence, and new life was put into these old institutions by the enlarged opportunities made possible by widening their curricula and enriching their courses of study. In other States a new kind of college was founded in order to teach agriculture and the mechanic arts. In still other States the funds arising from the national grant were either applied to the founding of a State university or were used as part of the funds of a State university; in either case they were set aside directly for instruction in such branches of learning as are related to agriculture and the mechanic arts. This movement, which was at work in the organization of the new land-grant college, was also taking hold of the older colleges, and the courses of study offered to the youth who matriculated in one of these institutions in the last quarter of the nineteenth century greatly astonished the father's mind who was a student in the middle of the century, by reason of the fullness and richness from which his son could elect such studies as afforded the best preparation for his after life. The sciences and their application to the various professions of life had found a place in the curricula, and it was soon found impossible for anyone to get more than a smattering of elementary principles if he should attempt to take them all.

There was great diversity of conception of the functions of a college, and especially did the land-grant colleges differ in their organization and practice. However, they honestly set about their work and had demonstrated their usefulness in such an emphatic way as to deserve further aid in the new Morrill bill of 1890. Many of them established courses shorter than the four years' course which had been handed down to them from the older colleges, and they sought degrees that were of lower significance than the old degrees. Often they required less preparation of those entering into the more practical lines of work than was asked of candidates for the severer courses, which were still kept to give proper dignity to the institution. Their aim was to turn out men who could actually do something; who could apply their knowledge to some useful purpose, even at the sacrifice of that mental culture which comes from the mastering of the principles of a science.

There was a complete shaking up of the older courses of study and a recasting of the forms of education offered to the youth seeking training in the college. The time-honored classical course was rendered more useful by giving enlarged attention to the English language, by the introduction of rational methods of study to history and science, and by the addition of one or more modern languages.

A scientific course, with or without Latin, was organized parallel with the older classical course; but at first the requirements for entrance upon the newer course were often less than were demanded from a candidate seeking admission to the older training. By reason of the poorer preparation for their duties, students in the latter course performed their work in an inferior manner, and, of course, received an inferior training. Even after entering college upon a lower plane than the classical students, often the course was completed in three years, thus making the degree given to be regarded as much inferior to the old-time bachelor of arts.

The degree of bachelor of science, or sometimes the degree of bachelor of philosophy, was introduced for such students as had completed the so-called "scientific" courses of study. This degree had very unfortunate treatment in its early history, but it soon recovered its standing when the colleges asked of the candidates for graduation preparation as severe and as extended as was demanded of the older course of study, and now it is held in the highest esteem. Candidates for degrees in the various scientific courses have as difficult work as the classical students, and while they do not pursue the same studies they receive the same degree of mental training from the severe exactness of their work and the broad liberality of their course. Even if something is sacrificed in not requiring so much specific attainment as is required of the classical students for admission, it can be more than made up by asking of the applicant greater maturity of mind and fixity of purpose.

If college courses are to be judged by the careers of the men who have taken them, we feel justly proud of the training that we have given in the courses of science, agriculture, and engineering. These men have measured up with the classical men in every duty and have stood shoulder to shoulder with their fellows in this preparation for life. They have not fallen behind the men who have studied the classics in culture, for that indefinable something that comes after years of association with great minds comes not less surely to the student of science than to the devotee of the classical literature of the world.

The new education, however, did not stop with the addition of one degree to denote the accomplishment of undergraduate training. It makes the head swim to contemplate the number and significance of the degrees given by American colleges. In the Standard Dictionary an attempt to give the degrees offered by the "leading universities and other educational institutions" occupies nearly three whole columns—almost an entire page of that mammoth publication—and even then the list is far from being exhausted.

Every possible phase of education or direction in which it may be applied has its own degree; every occupation, calling, or business claims the distinction of a degree. Whether a single science is studied, or a group of sciences so correlated as to fit for some specific end, the completion of the study is followed by the granting of a degree indicating that the student has accomplished such course of study. It makes one dizzy to follow the great diversity of possible degrees to which such a plan leads.

The medical course in this country leads to an abominable system of degrees; but custom has so fixed the title of doctor as synonymous with the profession of the physician that it is hopeless to make an effort to change it. However, the physicians do not make any distinction of specialists, only having distinctive titles for dentists, veterinarians, and compounders of medicines.

The etymology of the term "bachelor" is not baccalaureus, fancifully derived from "bay berry," "the laurel-crowned one," but baccalaureus, originally vacca laurius—vacca, afterwards written bacca, and laurius, changed to laureus to conform to a fancy forced upon it—"cow driver," "an apprentice," or a soldier who has not yet risen to the dignity of carrying the standard. The word is thus peculiarly fitting for the first collegiate degree. A movement has lately set in that promises to reduce the number of degrees, and it is hoped that the land-grant colleges will unite in helping it along. All those colleges now require of the candidates who annually present themselves for admission to the college about the same grade of preparation. Men who are admitted to any work of lower order than the freshman grade are not looking forward to taking a degree, and those pursuing any course less extended than the four years' courses are sufficiently rewarded by the knowledge and training they have received.

The degree of bachelor of arts has been from the first the distinctive degree of the man who has studied Latin and Greek; but it has lately been given to the man who has studied Latin only. This degree, in my judgment, out of respect for this old custom, should be given to those two classes of graduates only. The degree of B. S. should be given to the graduate of any other course, and the studies in which he has specialized or the direction in which his profession lies can be added in his diploma. The B. S. degree should be put on the same level as the B. A. degree in preparation asked of the candidate and in the length and severity of the course leading to it.

Some of the engineers are making a special plea for a degree to be known as bachelor of engineering. They claim that this degree should be given after the completion of a course of studies so related to each other as to prepare the student for undertaking the complex duties of the engineer. They recognize that there are too many subidvisions of the modern engineering profession to give each its appropriate degree.

At first civil engineering, as distinguished from military engineering, had alone to be provided for. Soon mechanical and mining engineering, to be followed by electrical engineering, entered into the field, and now we have chemical engineering, sanitary engineering, textile engineering, landscape engineering, promoting engineering, and so on ad nauseam. Agriculture as an industry has the same claims as the profession of engineering, and it calls for a knowledge of science and training in its application as wide and as thorough as are demanded by any of the industries of life. Some colleges give the bachelor of agriculture, others the bachelor of the science of agriculture. The horticulturists, the pomologists, the agrostologists, and various other specialists may insist upon giving the degree of bachelor of the particular branch of agriculture in which the student has received his undergraduate training.

The only way to stop the multiplication of degrees is to come to some rational plan, and I am glad to see that most land-grant colleges have aready put in practice the granting of only two degrees, the bachelor of arts and the bachelor of science.

To conclude, I think the land-grant colleges should limit their degrees upon the completion of an undergraduate course of study to the degrees of bachelor of arts and bachelor of science. The former degree should be given to the graduate of a course of study in which Greek and Latin, or Latin alone, of collegiate grade, formed a part of the regular work of the course. The degree of bachelor of science should be given to students upon the completion of any of the other courses, and it should be added in the diploma in what lines they directed their studies.

The degree is simply an abbreviation of the diploma, and the title merely indicates that the student has received the training of the undergraduate course of a college. The name of the college may with great propriety be included in parentheses after the degree. For the second degree resident graduate study or successful practical work should be required, and then the degree should be in keeping with the work that has been done.

A. B. Storms, of Iowa. The tendency of the older eastern institutions is to simplify the matter of degrees, as the paper states, and there is evident necessity for this. Originally the bachelor of arts degree implied that the student had pursued a certain well-defined course of study, the courses of study leading to the degree being limited. It was assumed when this degree was given to a man that he had studied Greek and Latin, or at least Latin. With the growth of scientific studies, however, there has been a great enlargement of the curricula of the schools, with a multiplication of bachelor degrees of various kinds. I do not think the bachelor of science degrees are sufficiently definite as significations of the courses pursued. I would like to add the designation of the line of study, as, for example, bachelor of science in agriculture. Bachelor of science means that a student has pursued the general scientific course. When we give the degree of bachelor of science in agriculture it means the student has pursued the agricultural course, and I think that is essential. I do not believe you can radically change the degrees that are already fixed, like those of engineering, veterinary medicine, etc.

H. C. White, of Georgia. I suppose we all recognize that no baccalaureate degree should be given except on the completion of a course of study reasonably satisfactory to the faculty as indicating that the man who pursued it has had a certain amount of general training in which there may have been certain special lines of work. Now, the difficulties that have confronted the faculties—certainly the difficulties that have confronted our faculty through our entire history—is to determine just what lines of special work we shall admit for our baccalaureate degrees. It of course touches the broad question which was in part discussed at the National Association of State Universities the other day as to how far professional training might be admitted into the years of the man's college course usually dedicated to his undergraduate work. In our technical courses in the sciences I fancy we have less trouble with the degree given of liberal arts. We have less trouble because some of our technical sciences are pedagogically of such value in science training that we have had no great difficulty in permitting our undergraduates to take certain lines which might be regarded as specialized lines. Now, assuming that they may take these various specialized groups in agriculture, or even in pure sciences, or the application of pure sciences and chemistry—we have such an instance in our own case, that of engineering—that the faculties are careful that the number of years which are dedicated to the undergraduate work shall include just the study which will give the man the necessary mental training and discipline to put him side by side with the man in the liberal arts course; that is to say, in the general collegiate training, we started out by differentiation in the name of the degree. We gave the degree of bachelor of engineers, and also bachelor of agriculture, and we gave the degree even of bachelor of chemical science at one time, and the tendency was to differentiate in the name of the degree. We found there was one effect of this in the mind of our students. When a man came and entered, for example, he would enter in the freshman class for the degree of bachelor of engineering. Before he passed into the sophomore class he would want to substitute this or that or the other study for something we thought better for his general training in the freshman work, and so eventually we came to the conclusion—and it is a conviction with us, because we have now tried it for a number of years—that it is safer to give the general degree of bachelor of science to every man who completes any one of the courses of studies. But we do follow the suggestion of Professor Storms. If it is desired by the graduate, we will indicate under the name of the degree "in agriculture," or "in engineering," or "in electrical engineering," but that is all we do designate. We give the degree of bachelor of sciences only, and indicate, as I say, whether agriculture, or civil engineering, or electrical engineering. I do not contend that is the best way, but of course it would be scarcely proper for me to undertake to discuss a paper and insist on something that we do not do ourselves. I rather think that is the safest thing to do at present. First of all, I think we certainly ought to insist that the degree should not be given to any man until he has had that amount of training and culture which will at any rate equal that he would get in the college of liberal arts. You can scarcely get the bachelor of arts man as yet to yield equal dignity to the degree of bachelor of agriculture. The degree of bachelor of science has come to be about as well established as the old bachelor of arts, and therefore I think the safe plan is to give the degree of bachelor of science with or without the inscription after the degree which would indicate the particular course.

Mr. BAILEY. The practice in the college of agriculture of Cornell University is not one that commends itself to me. I think the distinction raised by President Storms between general academic degrees and professional degrees is a very important one to keep in mind. We have professional degrees of civil engineer, and mechanical engineer, and doctor of veterinary medicine in our institution, as in others, and they stand for training in certain professional lines of work. In the university they give to the graduates of the college of agriculture the degree of B. S. A., hoping thereby to designate our belief that the college of agriculture is a professional college and is a college which leads to liberal culture, giving one of the two coordinate degrees that stand for liberal education, B. S. and B. A., B. A. standing for the culmination of the work up through the languages and B. S. for work up through the sciences. We differentiate from the old B. S. by adding an A. B. to it, and the whole title is bachelor of the science of agriculture, which I do not like. I should much prefer to have the degree bachelor of science in agriculture. There is a science of agriculture as distinct from other sciences. I think the important point for us to discuss and bear in mind is this: Is an agricultural course a professional course in the same sense as a legal or civil engineering course, or is it a course, as you say, of the liberal art course, which leads to a bachelor of science degree (or to the bachelor of arts degree), as distinguished from professional degrees? My own feeling is that in our own case, at any rate, the agricultural course should be considered to be a general culture course rather than a strictly professional course; that we should give it the title and designation of bachelor of science. I am very willing to add the designation of the course of study, as, for example, of bachelor of science in agriculture, and for all the different lines in which the degree is earned. It has been suggested that an agricultural student on graduation should get the degree of agricultural engineer, which perhaps would be abbreviated A E In other words, there is a tendency, I think, in some quarters to regard agricultural work as strictly professional work. I should think that unwise. I should prefer to give a general B. S. degree with the subordinate designation.

Mr. THACH. We have been established for some time as a scientific school. We have four or five courses in engineering, a course in agriculture and chemistry combined, one in chemistry, and one in mining engineering; in all, about eight specific courses. We confer only one degree absolutely, and that is bachelor of science. We regard that as specific and thoroughly well differentiated. I should like to see the land-grant colleges give one degree and require four years' good work, with as much language as possible for a well-established degree of bachelor of science. We designate in the diploma bachelor of science in certain courses, but we print and advertise the man as a bachelor of science. I do not see any use of being ashamed of that; it differentiates the modern theory from the old theory. I would like to see it done universally as far as possible. We also give the professional degrees of civil engineer, mechanical engineer, or electrical engineer, and so on for postgraduate work. I remember the time when B. S. was regarded as a little inferior, and men were clamoring for the A. B. degree for scientific work. But that confuses matters and does not indicate just the line of work pursued. We give one general B. S. degree, and later a master of science degree of the professional degrees as stated.

Election of Officers.

The hour for election of officers having arrived, President Nichols, of Kansas, nominated President R. W. Stimson, of Connecticut, for chairman of the section, and President Fellows, of Maine, nominated President K. L. Butterfield, of Rhode Island, for secretary. There being no other nominations, the secretary was by vote directed to cast the vote of the section for these gentlemen for the offices named.

For members of the executive committee there were nominated Messrs. H. C. White, of Georgia; W. O. Thompson, of Ohio (who withdrew his name); E. R. Nichols, of Kansas; J. L. Snyder, of Michigan; L. H. Bailey, of New York, and J. C. Hardy, of Mississippi. On a ballot being taken Messrs. White, Snyder, and Bailey received the highest number of votes and were declared elected.

Action on Resolutions.

The resolutions on cooperation between the stations and the United States Department of Agriculture (see p. 62) were read and approved by the section, as required by the constitution in case of all questions of administrative policy.

The resolution of Director Armsby regarding appropriations for stations and in support of the mining school bill (see p. 43), and that offered by Dean Davenport, relating to the extension of the franking privilege to engineering experiment stations (see p. 64), were also approved.

A similar resolution regarding the franking privilege for extension work publications (see p. 64), offered by K. L. Butterfield, of Rhode Island, was adopted.

The section then adjourned to meet after the evening session of the general convention.

Evening Session, Wednesday, November 2, 1904.

The meeting was called to order at 9.45 p. m. by the chairman, W. E. Stone.

What Can and Should be Done to Increase the Interest in and Appreciation for the Agricultural Side of Technical Education?

J. L. Snyder, of Michigan, presented the following paper on this subject:

The oldest agricultural college in this country will celebrate its fiftieth anniversary three years hence. At the opening of this college, and for many years thereafter, there was very little systematized knowledge which could be taught to students in theoretical or practical agriculture beyond the ordinary operations of the farm familiar to every country boy. The knowledge of science as related to agriculture was very meager and was not systematized nor in such form as to be readily used in class instruction.

Farming was a very simple operation in those days. Professor Hamilton tells of an inventory of the farm machinery and implements in use on one of the best 200-acre farms of Pennsylvania fifty years ago, the full value of which was $73.50. The equipment on such a farm to-day would be worth from $1,000 to $3,000.

In those early days students were given almost the same work as offered by the scientific department of other colleges. The instruction in agriculture was given in the field, largely by performing the ordinary tasks of clearing, ditching, fencing, and tilling the soil.

From this chaotic condition agricultural knowledge, by the arduous efforts of a few able men, began to expand and develop, certain subjects became prominent, and information relating to these subjects was systematized and gradually worked into such form as to be readily adapted to class instruction. This fund of information, both practical and theoretical, has been added to and enriched year by year. Under scientific, painstaking instructors it has been worked into pedagogical form, and courses of study with science as a basis have been developed, until at present the agricultural side of technical education can present a respectable appearance in the educational world.

More has been accomplished during the last decade than was accomplished during the four preceding. Until very recently technical courses in agriculture could not rightfully claim equal standing with technical courses in medicine, law, or engineering. At present, however, many institutions have placed certain courses in agriculture on a par with technical courses in the subjects just mentioned.

It is not claimed that all courses in technical agriculture should be of this grade, but if they are offered as four-year courses leading to a degree they must give the equivalent amount of work for that degree or lose the confidence and support of educated people in other callings and professions.

The agricultural side of technical education to become popular and meet with success must have the support of the most intelligent and best people of all classes. It is of the first importance that public school teachers, professional men, and the leaders in all lines of learning and industry shall have a favorable opinion of the work offered in these courses. They can know but little in detail of the work offered, but they can and do know, in a general way, whether the institution or department is turning out men who are prepared to rank with other college men in general training and development, and who are able to fill well the positions intrusted to their care.

To gain and maintain the confidence of the public technical courses in agriculture should be clearly outlined. No work should be placed in a course which the institution is not prepared and ready to give. It is pernicious and dishonest to outline subjects and courses in a catalogue or yearbook which the professor in charge knows will not be called for or the department is not prepared to give, however great and pressing the demand. The public can not be long misled by printed outlines.

The object of each course should be clearly stated. There is a useful and legitimate field for short courses and special courses from one week to four years in length, but let the object be so definitely stated and the work so clearly outlined that no one will be misled thereby. If the course is to lead to a bachelor's degree, let the requirements for entrance and the time and work required be such as to compare favorably with other technical courses leading to the same degree. One of the quickest and surest ways of discrediting a good thing is to make it cheap—cheap in the sense that it can be secured for a less amount of time or labor than is required elsewhere for the same article. The demand for a cheap article in education comes from those who usually are of little credit to an institution after their course is completed. The good students are not looking for soft snaps. They do not desire to enter the course which requires least for entrance and the minimum amount of work for a degree. Many good men have been lost to agriculture because they were too proud to enter upon a course of study tabooed and laughed at by students in other departments, largely on account of the inferiority of the work, both in quantity and quality, as compared with that offered in other departments. Happily these days in most institutions are past.

Courses must be technical. Their object is to impart specific information for definite ends. General culture is a laudable acquirement, but it must play a secondary part in technical courses. In the early stages of agricultural education courses of study embraced many subjects which, while good in themselves, bear no close relation to either the science or art of agriculture. They must give way to subjects which are more specific and technical in character.

In other words, technical courses in agriculture must become in character similar to the courses now given in medicine, law, and engineering.

But every technical subject should prove its worth before being given a definite place in the course. A small section only of the great sphere of knowledge can become a part of the curriculum. The man in charge of a subject is not always the best judge as to the prominence such subject should be given in a course of study. His nearness to the subject usually distorts his vision. Better let good courses in advanced English, history, and political economy remain in the curriculum for the present rather than displace them for technical courses which are half-baked, poorly arranged, and do not form a definite and important place in the sequence of studies.

Technical courses in agriculture, in order to have and hold the respect and confidence of educators and educated people, must be in charge of scholarly, well-trained men. These men must compare favorably with teachers in charge of other departments of college work. Narrow, conceited enthusiasts may, for a short time, with hobbies which in themselves are good, gain the attention of the public, but in the end they do the cause of agricultural education harm. Students, even more than the public, are apt to measure the value of a study by the scholarship, dignity, and magnetism of the man who imparts said information. There is a proper place for overalls and rubber boots. It does not lessen a man's standing or dignity to wear them when necessary, but there is no virtue in them per se. The class room for students in practical agriculture should be a model of neatness, cleanliness, and order. It should ever be kept in mind that the first object of education, and even of technical education, is to make men. There is a great danger that too much emphasis may be placed on the commercial value of such training. A distinguished educator, in looking over the equipment of an agricultural school a few years ago, remarked that everything that was shown him and every word said by those in charge emphasized the opinion that the sole object of the institution was "to teach young men how to grow more corn to feed more hogs, to buy more land to raise more corn, etc."

Even short-course students should receive some intellectual awakening. They should be introduced to books and, if possible, led to see that "we live in deeds, not years; in thoughts, not breaths;" and that "he most lives who thinks most, feels the noblest, acts the best." They should be taught that, after all, the greatest enjoyments are intellectual. No man compelled to labor for a living, as we all are, has greater opportunity to feed his intellect from the great storehouses of science, history, and literature than the "man with the hoe." He should be given an inspiration to look up. Hence the great necessity that teachers of agriculture should be men of broad culture and inspiring personality. They should know much more than the subjects which they are required to teach. They should be college-bred men in the fullest and broadest sense of the term.

It is to be very much regretted that so many able teachers of agriculture seem to feel that they must make their reputation outside of the class room. They write for the papers or carry on experimental work, while the students, who have been attracted to the college largely because their names were printed as teachers of agriculture, labor on under the instruction of young, inexperienced subordinates. There are other bright young men in agriculture who are endeavoring to find a crosscut road to success. Class-room work is too slow for them. They seem to imagine that they can, through the agricultural press, boost themselves into notoriety and fame. Very short-sighted policy. The men whose good opinion and confidence they must secure before promotion comes are entirely too wise to be misled by any such process. Young men must learn not only "to labor," but "to wait."

Again, if agricultural education is to attract and hold the attention and confidence of educated people, it must be accorded equal advantages in equipment and buildings with the other departments of the colleges or universities. A good building in a prominent place on a campus has a great influence in establishing in the minds of students and the public a high regard for the department so housed.

In most States it has been very difficult to provide buildings and equipment necessary to meet the demands made by those desiring higher education along the older and established lines of work. As there were few students in technical agriculture, buildings were erected to meet the needs of the greatest number. Agriculture usually came in last and got little. This had a tendency to belittle it in the eyes of the people and worked great injury to the cause of agricultural education. It is not the function of a university or college maintained by taxation to simply meet the present demands, but it should rather stimulate and create demands for such types of education as shall contribute the greatest good to the Commonwealth.

As the industry of agriculture is fundamental, and as our Government, in recognition of this fact, makes annually large appropriations for agricultural education, it is the plain and imperative duty of all land-grant colleges to build up strong, independent departments of agriculture and to encourage young men in every way possible, even to the remittance of fees, to make a thorough, scientific study of this subject. Short courses should be provided for those unable to take the longer courses. Through the experiment-station bulletins and farmers' institutes, knowledge of practical, everyday problems should be brought home to the farmer who is unable to avail himself of the advantages offered in the class room.

If the agricultural department of a university or the State agricultural college, in equipment, buildings, teaching force, and courses of study, is such as to command the respect of all thinking people, how can the interest in and appreciation for the work of this institution or department be increased?

It was the intention of the writer at one time to prepare an answer to this question from information furnished by the various institutions engaged in this work. But after preparing a blank asking for specific information on twelve or fifteen points, it came to his attention that there were at that time several such blanks on his desk unanswered. His heart failed him and he decided, even at the risk of unfavorable comment, to give briefly the methods used by his own institution in bringing before the public, and the farmers in particular, the advantages that institution has to offer to the young people of Michigan.

It may be proper to state at this time that this college has always maintained very friendly relations with the public schools, and especially the high schools of the State. Members of the faculty belong to the State teachers' association and have an extensive acquaintance among public school men. This has, in many ways, contributed to the growth and stability of the college.

For advertising purposes $2,000 is set apart each year. This is expended through the president's office and almost entirely within the confines of the State. Methods differ somewhat from year to year. As an indication of the plan ordinarily pursued, a brief outline of the work done last year will be given:

About the 1st of January the college calendar was issued. This gave views of buildings, landscapes, laboratories, interior views of laboratories, etc. An edition of 6,000, costing about $325, was distributed to all the high schools of the State, alumni, newspapers, State officers, country ministers, and the leading agriculturists of the State. The college has issued a calendar each year for the past seven years and the results from this source of advertising have been very satisfactory.

The college issues quarterly bulletins in editions of from 5,000 to 10,000. The first edition is issued in February. This gives the programme of the round-up farmers' institute, together with information concerning the college, and especially the agricultural department. This is mailed to all the officers of the county institute societies and to those who have in any way been interested in the work of the institutes, also to other prominent farmers throughout the State. The proceedings of the round-up institute are printed and issued as a supplement to the February bulletin. Ten thousand copies are in this way distributed among the farmers of the State.

The May bulletin is designed to give information to young people who may be induced to enter our long courses. These are sent to the members of the senior class of each high school of the State and to several thousand other young people whose names we have collected from farmers' clubs, granges, country ministers, alumni, old students, and various other sources. To this list of names are sent also several special editions of our college paper, including the commencement number.

The August bulletin is also sent to this list of names, as well as to all likely to be interested in the excursions to the college. It gives information concerning these excursions, which take place during the third week of August. Four railroads enter Lansing. One railroad is given two days for excursions, the other three one day each. We arrange several months beforehand with each railroad, having an understanding as to the territory to be covered and the rates to be charged. The railroad furnishes the college printed matter advertising the excursions. We mail this to all the granges, farmers' clubs, post-offices, newspapers, former students, and prospective students, and others interested within the territory to be covered by the excursion. As one railroad has a branch leading to the college, these excursion trains are run into the campus. We send student guides in uniform out 20 or 30 miles to meet the trains and distribute little maps of the college grounds with specific information as to what can be seen in each building. Buildings are placarded and numbered. There are also on the campus a number of students in uniform ready to show people about. A number of wagons carry visitors through the experimental plats and orchards. Every department of the college is open with one or more persons in charge. Sideshows, agents, and fakirs are not permitted on the campus. Meals are furnished on the grounds at reasonable cost, but the visitors bring baskets of food with them and eat from the tables provided under the beautiful shade trees. These excursions are patronized almost exclusively by farmers and their families. Many of them return each year with the annual excursion and always seem to be much interested. About 8,000 people annually visit the college on these occasions. The excursions are of no expense to the college except the small sum paid out for guides and a little printed matter and postage. Many students who expect to enter take advantage of these excursions to visit the college and make arrangements for rooms and board.

Soon after the fall term opens arrangements are made to advertise the short courses given during the winter. Names are gathered from the farmers' organizations, institute workers, census enumerators, crop reporters, creameries, cheese factories, and old students. The November bulletin gives an outline of the short courses and all information desired by those wishing to enter. Ten thousand copies are distributed for this purpose. Special editions of the college paper are also mailed to prospective short-course students. These special courses are also advertised in the agricultural papers of the State for one or two months during the fall. The long courses, during the summer months, are advertised in the religious papers of the State.

Occasionally special measures are taken to advertise the institution. Recently 200 Junior Annuals were sent to as many of the best high school libraries throughout the State. Last year our department of entomology sent to each of our leading high schools a box of specimen insects valued at $10. The endeavor is to do systematic, careful, conservative advertising. No particular subject or department is boomed at the expense of others; no member of the faculty is given an opportunity to boost himself and his department unduly. All endeavor to work together for the upbuilding of the institution. We work in harmony with the other institutions of the State. We are within the shadow of one of the great universities of the country, having at present in its campus over 4,000 students. This greatly increases the difficulty of securing students, yet we have all and even more than we can take care of properly with our present equipment. We hold strictly to the technical idea. Every male student is required to take either agriculture or engineering. We do not offer literary, classical, or general science courses. We advise students desiring such work to attend some other institution.

We try to show in our work and in our advertising that we have faith in agriculture and in agricultural education. We plead for a higher ideal and a higher life for the tillers of the soil. We believe that this uplift will only come through education.

There is one line of work not touched upon in this paper which would undoubtedly do much to arouse interest in agricultural education—namely, that of the teaching of nature study or elementary agriculture in our public schools. The experiences so far in this direction are not very encouraging. It will take a long time to make elementary agriculture or nature study a component part of public school work. It calls for a class of instruction which is far beyond the ordinary teacher of a public school. The time may come, however, when teachers for this work will be thoroughly trained and will be able to arouse interest in students such as will prompt them to attend the higher institutions of technical training.

What can and should be done to further agricultural education?

(1) Make our agricultural schools and colleges such as to draw the young people from the farm.

(2) Encourage and assist in the introduction of elementary agriculture into our district schools.

(3) Encourage the establishing of country high schools in which the teaching of agriculture will be a prominent factor.

(4) Impress upon the public, and particularly the rural population, through the press, from the platform, and in every other effective way, not only the great advantages of technical training in agriculture, but also the freedom and pleasures of country life.

We should remember that it has taken many, many years to develop the strong sentiment which prevails everywhere in favor of higher education. The pulpit, the press, and every intelligent force has been emphasizing the advantages of higher education for centuries. It may take many years to develop among the farmers of this country a strong sentiment in favor of agricultural education. We should feel encouraged with the results so far. What other great educational movement has made such rapid strides? The outlook is hopeful. Let us not grow weary in welldoing.

E. DAVENPORT, of Illinois. It is pretty well understood, and has been for a good many years, that the technical portions of the courses in our agricultural colleges are not quite so interesting to students as some other subjects taught. This has been due in many cases to the lack of men to properly develop the subject of agriculture, although the idea that the difficulty of giving good instruction in agriculture is due to the nature of the subject has not entirely passed away. The organization lists of the land-grant colleges show a tremendous difference in the number of instructors in agriculture, the figures varying from two-thirds of a man to over 20 men in different institutions. So far as I know the interest in agriculture in these institutions on the part of the student is about in proportion to the number of men who are teaching the subject. Excluding household science, which is hardly in the field we are discussing, the college of agriculture of the University of Illinois offers 73 courses in agriculture. Of these, 67 different courses are actually taught this year. The proportion of technical to nontechnical work has something to do with the interests of the student. I think we ought to consider whether a student should spend one-half or one-fourth of his time in agriculture. In our institution we expect him to spend one-half his time in this subject, but our object is to teach subjects, not to conduct students through set courses, the student making up his course of study out of courses of instruction offered by the institution. The students demand these specialized courses, and are demanding that they shall be still more specialized. We used to have a subject we called stock judging, in which the student was to judge horses a while, then cattle, then sheep, and then hogs, and we thought that was a proper unit. We learned that some students were especially interested in one kind of animal and not in the other kinds, and so we divided the subject. We put the light horses in a class different from the heavy horses, the beef cattle different from the dairy cattle, and we separated the sheep and hogs. We have men following each subject. To a man who is to be a producer of beef or a breeder of beef cattle information about dairy cattle is the veriest rubbish. Technical instruction to be of any consequence or interest to the student must be directly applicable to the business in hand. The student ought not to be required to waste his time with the kind of technical instruction which is of no use to him. It is our purpose, therefore, to so shape the courses that each student shall get the particular kind of technical instruction he wants or needs for a definite line of work. The problem before all of us is to so man the agricultural departments that we can not only teach the stock knowledge we have in hand at the present time, but can develop new sources of information. The unit is the subject to be taught, and not the numbers to be taught. If the agriculture is simple it takes fewer men, but if it is mixed it will take many men. It will take men enough to develop the subject, irrespective of the students. We now have more teachers of agriculture than we had students five years ago. And the contention was then we did not need any instructors until we had more students. I said, we will never have more students until we have more instructors. The moment we doubled our instructors we doubled our students, and so it will be everywhere. These students know what they want better than we do.

For years we temporized with the matter because we thought if we had few students we only needed a few instructors. It is as much trouble to teach one as a hundred. When I was a student of agriculture there was very little literature and no bulletins. If you had had 20 professors of agriculture twenty years ago there would have been, apparently, a great waste of money, and yet we would have got along much faster if we had been able to increase our numbers earlier. I read a report on household science the other day, written by a body of intelligent women, who undertook to say that household science some day would be a great subject in universities, but that no subject could be attempted by a great university until it could go in with all the dignity of any other subject and be as well taught as any other subject, and I said it would never get into the university then. Agriculture would never have gotten into any university or college if it had not begun until it was perfected. I am of the opinion that it is in the universities of to-day that agriculture has the best opportunity, because the theory of the university is that every department in it may offer all the courses that the genius of its men will permit, that the department may do just as much in the way of expansion and in the way of courses as the money at its command will make possible. The theory of the college is, on the other hand, that there is a set course, and when the course is full there is no chance for expansion. That is likely to be true of the independent agricultural college. As a rule colleges have set courses, and as a rule universities do not. Until agriculture can have in the colleges of agriculture that are distinct from universities the same opportunity for extension or subdivision as there is in universities generally it will be hampered in its development. I believe that every institution, whether a university or college of agriculture, should give the agricultural department every opportunity to divide and subdivide, and supply it with plenty of men and money. In the agricultural colleges there must be almost unlimited election in agriculture, because such technical work must be elective. Agriculture, in order to prosper, must have almost unlimited means, unlimited numbers of men, and unlimited privileges.

W. M. Hays, of Minnesota. You say you divide the work about half and half. How do you arrange this?

Mr. Davenport. If a man graduates from our university he takes certain prescribed studies. Those are arranged so that half are agriculture and the other half not agriculture. He has about one-fifth of his time to use as he pleases. He can make it a little more than half technical, or he can make it exactly half technical. We distribute the technical from the first year until the last. The student takes some agriculture from the first. Our courses are so arranged that if the student follows our advice he begins agriculture, science, and literature when he enters the university.

Mr. Bailey. There is a point of view which I would like to suggest, which I think marks a wide difference between the practice of the agricultural college of the University of Illinois and some of the other institutions of similar grade, and that is whether some of these courses, looked upon as more directly professional, are not fitting men for rather narrowly specialized vocations in life, whereas others of us are teaching broad agricultural courses, which are intended to fit a man for the undertaking of the larger affairs of agriculture and of country living. In our own college of agriculture we do not expect to fit a man for the technical work of stock judging, or the technical work of corn breeding, so much as we do to educate the man and to fit him to be a strong and resourceful man and able to take up any particular kind of work he wishes to later in life.

Mr. DAVENPORT. I may say that in the University of Illinois the college of agriculture is not a technical college in the sense the engineering college is. An engineering course is an absolutely set course, and has little or no time for the language, literature, and other of the nontechnical subjects which are required for graduation in the agricultural course. The demand for engineering students is so large, the public calls for so much technical information at once upon graduation, that they are compelled to devote practically all the time of the college course to strictly technical training.

Mr. HENRY. Assuming it is right to train an engineer that way, I think the same is true of agriculture. The engineering course has been longer in developing and has had more highly trained men than agriculture.

The CHAIRMAN. It is not necessary to success in agriculture that a man should have the same training that is required in engineering. You all know very well that there are hundreds of farmers making a good living and making money who have had no technical training in school at all, and there are going to be such men for a good many years to come. That is, the conditions are such in agriculture in this country that an uneducated farmer can acquire land, make money, and succeed at farming. That can not be done in engineering. Neither is it profitable to give him training in engineering of the brief superficial kind which you can give men in these technical courses of agriculture. You can not accomplish successful engineering training without a good many years of mathematics. Mathematics is not required to get a degree in agriculture. So that I should say that a professional course of study in engineering involves a good deal of well-defined and clear-cut training, but that the course in agriculture is not yet on the basis of the professional course, although it is technical. I make that distinction. The trend of the discussion seems to be that it is not necessary to put the same amount of training into the engineer that it was into the agriculturist, in order that he may meet the demands of the day, but I do not agree with that, because the farmer can meet the demands of the day and not have a bit of training, and there are hundreds and thousands of farmers doing that every day; but there are not many successful engineers who have not had a pretty thorough training.

Deans Henry and Davenport dissented from the position that untrained farmers are succeeding in any proper sense or complying with the condition of good agricultural practice, that they shall occupy the land and leave it as good as they found it.

Mr. HENRY. The San Joaquin and Sacramento valleys have been practically ruined in the last thirty or forty years. The State of New York has areas in it that have been robbed of their fertility by improvident culture. In Europe I have traveled over lands that were probably cultivated in the time of Julius Caesar, and I saw wheat there yielding as high as 60 bushels to the acre. In America we have skimmed over the land and taken the best of its fertility. People buy land and when they ruin it, or get it up to a certain price, they go to another place. This is due both to lack of technical training, and to the business idea of getting the money out of the land and leaving it.

It will be found, I think, that the unschooled men who are making a success of farming are nevertheless self-educated men, and in a way are as well educated as the engineer is.

Mr. DAVENPORT. The engineer has got to meet the demand of the trade. The farmer also has to meet the demand of the trade, and in addition he has to meet a certain demand of the State. This generation of farmers must not be permitted to occupy to the disadvantage of the oncoming generation. There is a broader demand on the farmer than rests upon the engineer.

C. F. Curtiss, of Iowa. I believe that in our agricultural work we are tending strongly toward training the farmer the same as we do the engineer. We are loading our courses of study up with more and more technical work every year. We are going to be very soon on practically the same basis. It is true we have not had that heretofore; we were not in position to get it; we did not have the technical men in our faculty. The conditions are getting to be such that the young farmer is going to be obliged more and more largely each year to sell his services on the market, just as the young engineer does. I think less than 50 per cent of our agricultural students are in such circumstances that they can return to farms of their own proprietorship, or likely to come to them by inheritance. There is going to be an increasing demand for the young men who have had the thorough technical and practical training which renders them capable of taking charge of a farm, as an engineer takes charge of a plant, and making it a profitable investment for the owner. The demand is more largely for thorough training in agriculture. And I believe we are going to load up our courses (and some of the institutions have already encountered the difficulty) so fully with agriculture that there will not be room for mathematics, science, and the culture studies. These studies are giving way and must give way more largely in the future than they have in the past to technical agricultural studies.

Mr. Bailey. To all requests for men to take charge of large agricultural enterprises I always reply that we can not send recent college graduates to fill such positions. That is not the way the agricultural student is trained. The engineering enterprises are organized enterprises. The young man goes to do a special piece of work under direction, whereas the agricultural student who takes charge of a 250-acre orchard, for example, not only has to direct the technical work of spraying, etc., but he has to do with the management of men and other executive details, and that demands experience. The engineer who is the manager of men is the one who has been out of college two or three years, and therefore has had experience in the management of men.

I sometimes wonder, when we are splitting up our agricultural courses into small units, whether we are not overloading them with very minute divisions of subjects and are not likely to substitute training for education, mere technical, manual, and special skill for real mental power.

So far as we have organized industries in agriculture, as we have in engineering, I think the educational demands are parallel to a large extent, and the experience of the engineer is useful to us. So long as the larger part of the subject of agriculture is unorganized, I do not see how we can adopt the kind of training the engineer receives. I suppose, as time goes on, we shall find increasing demand for particular and technical special lines of training for the agricultural man.

J. L. Snyder, of Michigan. The inference which could be drawn from the remarks made might lead one to think that the engineering courses were almost entirely technical and that our agricultural courses were at least half liberal or included subjects that would give discipline. We all know that our engineering courses are exceedingly strong in mathematics, and we also know that the disciplinary value of mathematics is very great. In addition to that, engineering students must have a good knowledge of English. If they do not have it when they enter the school, they must get it afterwards. Engineering graduates are well trained in English. They must also have considerable science work. On the whole, our engineering courses give very good disciplinary training. On the other hand, if we make our courses in agriculture thoroughly technical, we lose the disciplinary value that is attached to the courses of engineering. If we divide up our courses in agriculture as finely as some have recommended, I think that to a large extent the disciplinary value will be lost, and we can not afford to do that. First of all, we must have men of some power. A man may know all about agriculture, or certain subjects in agriculture, and still be so lacking in power as to be worthless. We must not forget that, when we divide up our courses in agriculture into such small fragmentary pieces, we lose the continuity of study and that close application a student must give, for example, in preparing his work in mathematics. We throw away the great value of our enlarged courses, and we can not afford to grant degrees on any slipshod or fragmentary course of instruction which fails to give the great power and development that comes from a good four years' college course.

Mr. Bailey. You would distinguish, then, as I understand, between the training-apprenticeship idea and the pedagogical idea as the result in teaching?

Mr. Snyder. Yes, sir.

Mr. Curtiss. Do you not think that a student who thoroughly masters these technical subjects from start to finish gains power by it?

Mr. Snyder. That depends very largely on how they are taught. I do think that technical subjects can be presented in such a way as to give power, but I fear that if a student is allowed to enter college and select his work wherever he pleases and whatever he pleases that he will lose to a great extent that valuable training he would get from a systematic course laid out by an older head than his own. He must have a certain amount of English and a certain amount of science work back of his training. It is usually better to have the scientific training first. At one time we thought that the only way to do was to give the science first and the practical part afterwards. Now that view has changed largely, and in a great deal of our work I think the two come pedagogically together. But the student must have a scientific basis for his technical work, for the latter is not all art; there is a science behind it, and if he is going to receive thorough training he must have a foundation in science. I do not believe he can receive such an education as we expect four-year men to have, the men who receive a degree without thorough training in chemistry, physics, and the other natural sciences. I do not believe you can give a man an education which would entitle him to a degree simply by giving him the art without giving him the sciences.

Mr. Davenport. But is there not science in the subject itself if it is well studied and well taught?

Mr. Snyder. I think a great deal of this technical work could not claim to be strictly scientific. Of course it may be based on scientific principles, but if the student is not familiar with the sciences, he simply commits the definitions as based on science.

Mr. Curtiss. I wish to distinguish between splitting up a course into small fragments and concentration. I think that distinction should be clearly made. Take, for instance, the animal-husbandry training given in our own institution. We have separated the animal-husbandry training from the other training and established an animal-husbandry course. We have supplemented it with the scientific training that bears on the subject. We have also established a course in horticulture, reenforced with the greatest possible amount of science which bears on horticulture, and so with all of our courses. Instead of splitting up into fragments, we have concentrated and strengthened the courses to the largest possible extent. As regards training, force, and power, I do not believe the students have suffered by that kind of concentration where the subjects are properly related and the underlying sciences taught. In our institution the engineering courses are concentrated and rigid, and we are making our agricultural courses more and more of that type each year. The engineering courses have but very little of the general culture studies, the agricultural students have less of mathematics, but they have more of the sciences, and they have the technical studies which closely border on sciences when taught properly.

Mr. Davenport. I believe thoroughly that there is a scientific way to teach agriculture when we can find it. It is unscientific, I believe, to say to a man who wants to study beef cattle that he must first study sheep. We must try to meet the demand scientifically. Find the unit in his mind and meet it with the unit instruction. Concentration is the object sought, but let the technical training be done in the most scientific way possible. Of course, if the student changes his plans, the special information will be useless, and whether he changes his plans or not much of the information employed in the instruction will be discounted in a few years, but the training he receives, the attitude of mind, the ability to think and carry out a thing to its issue, will remain with him. The pedagogic idea is the main idea in it. If the student has announced his desire to study beef cattle, I should get him among the animals as soon as possible. I should let him understand he is studying beef cattle at once, but I should advise him to study chemistry at the same time. We require a year and a half chemistry before the student can study stock feeding. The moment he announces his desires we begin to frame up his course of study, and he works the whole thing together.

Mr. Henry referred to the rapidity of the growth of specialization in teaching agriculture since the agricultural colleges were first organized, and to his belief from the beginning that this would be the tendency.

After some further discussion the section on college work and administration adjourned.

SECTION ON EXPERIMENT STATION WORK.

Afternoon Session, Tuesday, November 1, 1904.

The section convened at 2.15 p. m., Chairman E. H. Jenkins presiding.

On motion, the section resolved to have but two afternoon meetings, viz, on Tuesday and Wednesday afternoons.

Organization of a Section on Botany and Horticulture.

The communication of F. L. Stevens, of North Carolina, filing an application from botanists and horticulturists, requesting that one of the sections of the association be devoted to their interests, was referred to the section for consideration.

On this subject L. H. Pammel, of Iowa, said:

I had an invitation from Professors Stevens and Rane to prepare a paper for this meeting. I was urged to be present to present a paper because on the interest manifested in the work would depend the organization of this section. I favor the creation of such a section, but I must confess the sectional meetings have not been entirely successful. I have attended five or six meetings of this association, but at none of these meetings did we have a large attendance of botanists and horticulturists. Inasmuch as this convention is largely a delegate convention, it seems to me it is rather expecting too much to have the station workers attend and pay their own expenses. It seems to me, however, that the station botanists and horticulturists have the right to know something about the working policies of the institution, as these are the matters most discussed. Under present circumstances you can never expect a large attendance from the station workers, outside of the director and president, who should by all means attend.

On motion of W. H. Jordan, of New York, the application was not granted.

FEDERATION OF AGRICULTURAL ORGANIZATIONS.

On motion of H. J. Wheeler, of Rhode Island, the chair was empowered to appoint a committee of three to secure, if possible, a federation of agricultural organizations in the individual States of the Union.

The chairman appointed on this committee H. J. Wheeler, of Rhode Island; C. D. Woods, of Maine, and H. J. Patterson, of Maryland.

UNIFORMITY OF TERMS USED IN AGRICULTURAL ANALYSIS.

Attention was called to the fact that the general session of the association had referred to this section the subject of nomenclature for fertilizer constituents. It was moved by C. G. Hopkins, of Illinois, and seconded by C. E. Thorne, of Ohio, that a committee of five be appointed to consider the nomenclature for reporting the analysis of fertilizers, soils, plants, and other agricultural products and materials; that this committee should confer with a similar committee from the Association of Official Agricultural Chemists, and report to this section at the next annual meeting.

The chairman appointed on this committee C. G. Hopkins, of Illinois; H. J. Wheeler, of Rhode Island; A. T. Neale, of Delaware; R. J. Davidson, of Virginia, and H. Snyder, of Minnesota.

PLANT BREEDING—THE SHAKESPEARE OF THE SPECIES.

W. M. Hays, of Minnesota, read a paper on this subject which was subsequently withdrawn.

B. C. **BUFFUM**, of Wyoming. One point brought out in the paper so ably presented by Professor Hays it seems to me was not given sufficient weight. In fact, he stated that a variety of apple was practically the same in any section in which it is grown.

The modifying influence of environment is very great. It is perhaps more strongly marked in the comparatively new arid region which I represent. In fact, my observation would lead me to suspect that the same "homozygotes" may have produced both the white man and the black man. A species supposedly fixed by careful and long-continued breeding when transferred to an environment very different from that under which it was formed soon becomes unrecognizable. I knew a case a short time ago of an apple which belongs to Professor Hay's species of the first class having no immediate modifying blood strains, as it is only a part of the parent, that was purchased by a western nurseryman from a firm in Missouri. The trees were sold to a farmer, and in five or six years, when they began to bear, the farmer sent samples of fruit back to the nurseryman to be named. He did not recognize the variety and sent the fruit to the Missouri firm, who, in turn, could not name the variety. It was sent to Mr. Taylor, of the U. S. Department of Agriculture, who reported that the apple must have been a Missouri Pippin, but its variation had made it almost impossible to recognize any characteristics of the variety.

The hard wheat when taken to the arid region from Minnesota begins to vary quite quickly, and in a few years the kernels of grain become very different. There seems to be a tendency on our arid soils, poor in nitrogen for glutenous wheats, to become starchy, and many of the grains take on a white, starchy appearance.

In live stock the same thing pertains. A son of Corrector which has been bred for heavy meat points in the chine and twist, if taken away from the corncribs and placed on a western range will begin to develop a form more nearly corresponding to the American bison which formerly occupied the ranges. He becomes heavy in front and light behind.

What has been gained by breeding in one place may be quickly lost under changes of environment and State. This is one of the strongest arguments for the maintenance of experiment stations in the several States, where work can be done suitable and valuable to the different regions of the country. In order that the farmers can make intelligent use of the results of our breeding they must be informed of its importance and learn to select, in order to keep up the improvement. In general, undirected variation brings about deterioration. Varieties do not stand still, whether or not they are being acted upon by the powerful forces used in artificial direction of breeding, and every farmer should be well enough grounded in the simpler principles at least to enable him to make continued use of an improvement.

L. H. PAMMEL, of Iowa. A number of years ago I had the good fortune to have taken up this question of varieties of fruits. I was astonished to find the effect that climate has upon the development of fruit. The Duchess grown in Montreal is very different from the Duchess grown in Iowa. The Montreal apple was far superior in quality. Again, I found that apples succeeded best or had the highest quality when grown where they had originated. Thus, such varieties as Spitzenburg, Baldwin, Grimes Golden, and others have a limited distribution where they attain the best quality. I was astonished last summer to find in Montana that apples succeeded in regions where frequent frosts occur. In fact I was told that in the Bitter Root Valley on one of the streams they had set out an orchard of fruit trees above 3,000 feet altitude, where frosts occur nearly every week in the year. But take another side of the question, and that is an important one to consider in connection with the breeding of varieties. Take the variety of wheat that Professor Hays has produced in Minnesota. This variety has produced an increased yield in Minnesota, but the same variety tried in the State of Iowa did not show this increase in yield. Again we all know that plants when grown in climates not adapted to them begin to show the effects of disease. Some years ago when I was investigating the disease of oats, and especially the variety most subject to the disease, I found that the Texas Rust Proof oat was severely affected with rust, but it is said to have been rust proof in Texas. We know then that climate is an important factor and that each region must do its own work in connection with the production of varieties. The varieties of wheat that have succeeded best in Minnesota will not do for Wyoming, and so on.

Professor Hays's paper was further discussed by W. H. Jordan, C. D. Smith, C. A. Keffer, C. G. Hopkins, and H. T. French.

For further discussion of the subject of plant breeding, see page 119.

AFTERNOON SESSION, WEDNESDAY, NOVEMBER 2, 1904.

NOMINATION OF OFFICERS.

The chair was authorized to appoint a committee of three to present nominations for the officers of the section, including two members of the executive committee. The committee appointed consisted of H. P. Armsby, of Pennsylvania; W. A. Henry, of Wisconsin, and R. J. Redding, of Georgia. (For report, see p. 65.)

TOPICS FOR DISCUSSION NEXT YEAR.

On motion the subjects of soil investigation and of demonstration work by the stations were selected for discussion at the next annual meeting of the section.

PLANT BREEDING.

N. E. Hansen, of South Dakota, read the following paper on Methods in Breeding Hardy Fruits:

My purpose in this brief paper is simply to emphasize some of the points brought out in Bulletins 87 and 88 of the South Dakota station published this season. In crossing various fruits I have found it of decided advantage over the old outdoor method to do the work under glass. The trees, shrubs, and plants are raised in pots, boxes, or tubs for a year or two before blossoming time. In winter they are stored in a specially constructed tree cellar, where they are kept dormant and even allowed to freeze somewhat, with enough windows to afford some light. In late winter or early spring they are brought into the greenhouse, and the crossing is done when the flowers are ready. Only a small part of the blossoms are emasculated; the remainder are removed while still in the bud. No sacks are necessary, as a rule. As soon as possible the plants are put outdoors to ripen the wood. When there is no room in the greenhouse the tubs are taken direct from the cellar to their permanent summer position late enough to escape frosts.

As a whole, the method demands close attention and careful manipulation. While visiting orchard houses in Europe in 1894 and again in 1897 the thought came to me that this method could be utilized in experiments in the prairie Northwest. The applicability of this method elsewhere remains to be determined.

The use of dwarf stocks is necessary, as the Paradise for the apple, quince for the pear, and the western sand cherry for the stone fruits.

Considerable success has been secured in hastening the fruiting of cross-bred seedlings. For instance, strawberries originated one winter by crossing the wild with the tame have been raised up to fruiting size the same year outdoors and fruited in pots under glass the following winter. This saves much time in selecting varieties for propagation, and also hastens the work of propagation by our being able to pot many layers before transplanting to the field.

In handling a quarter of a million fruit seedlings I find many interesting side lines of investigation presenting themselves, but just now the main effort must be to originate a few varieties of the various orchard and small fruits worthy of a permanent place on the present limited fruit list. Some of the seedling variations which present themselves make me feel confident that Dr. Hugo De Vries in his theory of mutation hit the nail on the head. It is certainly a very helpful thought that new forms worthy of specific rank can originate as sports; that evolution is by steps instead of being a long and very gradual upward slope. Members of the legislature who have the dispensing of funds will certainly find more comfort in the theory of De Vries than in that of Darwin. My experience at first hand with many thousand seedlings of native and cultivated fruits and plants certainly compels me to believe that the evolution of new species as the result of man's effort intelligently directed is more like the labor of an inventor of machinery in his workshop than that of an observer of an ever changing panorama. In brief, plant breeding is the inventing of new plants, using material as furnished by nature, and the time necessary for the work with modern scientific methods is very much shorter than that usually considered necessary. The modern plant breeder rides in his automobile on the highway of evolution. And perhaps Mendel's law and the De Vries mutation theory are two of the wheels.

T. L. Lyon, of Nebraska, discussed Improvement in the Quality of Wheat, as follows:

My object in presenting this matter at this time is to call attention to the difficulties that present themselves in attempting to improve the quality of wheat. So far as I have been able to ascertain, efforts at improvement in the quality of wheat have not dealt with the individual plant, but with the progeny of otherwise desirable plants. In selecting plants for improvement the selection has been based primarily on the yield of grain, stiffness of straw, rust resistance, or other points of that kind. After several generations had been produced the selection was then applied to quality. The result of this has been to limit the number of plants selected for quality, and thus to curtail the possibility of improvement in that direction.

The reason that selection for improvement has not gone hand in hand with selection for yield in the individual plant is because we have not had a method for selecting plants with reference to the quality of the wheat itself. My object, then, in starting this work was to find some method of sampling the plant that would give an indication of its quality.

In my work a number of plants of Turkish Red wheat were analyzed, each head of the plant being harvested separately, and the analysis being made separately of each head, all kernels of each head being used. The data obtained show that there is quite a difference in the proteid content of these various heads, and that it would not be safe to take the analysis of any one spike as representing the composition of the plant on which it grew.

Analyses were also made of groups of spikes on the same plant—that is, supposing that a plant bore ten spikes, we would take five of those in one group and five in the other group, then shell out all of the kernels in each group and analyze each group separately. In other words, we made an analysis of half of the kernels on half of the heads of the plant. The results attained in this way were very much closer than the results of analyzing the separate heads. Thus by taking half the number of heads of the plant and analyzing them we got a fairly good sample of the whole plant. Separate analyses made of the two rows of kernels showed small difference in the total nitrogen and proteid content of the samples.

In carrying on our work we have adopted the practice of sampling each head by taking one row of spikelets as a sample for analysis and the other row of spikelets as a sample for planting; then by sampling each head on the plant we get what we consider to be a good average sample of the plant for analysis.

The proteid nitrogen content of 800 spikes of Turkish Red wheat selected in the field in 1902 with special pains to secure heads that were thoroughly matured and free from disease was determined and the seed planted. From the crop thus obtained selections were made and kernels from entire plants were sampled and analyzed. The minimum content of proteids, that is, proteid nitrogen multiplied by 5.7, was 6.38; the maximum, 28.21; showing a very large range and indicating the possibility of increasing very largely the nitrogen content by selection. Analyses of 351 plants grown from the above in 1903 showed a minimum proteid content of 5.84 per cent and a maximum of 33.34 per cent.

When the analyses of the original 800 spikes were made determinations were also made of specific gravity of the kernels in a considerable number of the heads. The weight of the kernels on the low nitrogen content heads was found to be somewhat larger than it was on those of high nitrogen content. While the decrease was not regular, there was a slight tendency for the yield to decrease as the nitrogen content increased. The weight of the average kernel also agreed with the weight of the kernels on the spike, there being in the main a slight decrease in the weight of the average kernel as the content of proteid nitrogen increased. The number of kernels on the spike did not vary particularly. The volume occupied by the kernels decreased, or had a slight tendency to decrease, as the proteid nitrogen content increased. The specific gravity decreased regularly as the content of nitrogen increased. The proteid nitrogen in all the kernels increased as the percentage increased, and the proteid nitrogen in the average kernel increased as the percentage increased; so that, in spite of the fact that the kernels became somewhat smaller and lighter, the total production of nitrogen increased as the percentage increased. In other words, a selection based on increase in percentage of nitrogen would increase at the same time the total production of nitrogen.

Similar figures for the nitrogen content of all of the heads of the plant of the crop of 1903, instead of one head as in 1902, also showed that the number of kernels decreased slightly as the percentage of nitrogen increased; the weight of the kernels also decreased as the percentage of nitrogen increased; the weight of the average kernel seemed to vary more than it did before, but the tendency was for the weight to decrease with an increase in the percentage of proteid nitrogen; the grams of proteid nitrogen in the kernels increased in the main as the percentage increased; and the grams of proteid nitrogen in the average kernel increased as the percentage increased. The increase in the average kernel was very large.

We discarded all kernels that were not fully developed because it is well understood that kernels that had not fully ripened would have a higher nitrogen content than those that had.

In the crop of 1903 we also determined gliadin and glutenin in most of the plants. Our object in doing this was not very definite. Of course we were attempting to estimate the constitutents that go to produce gluten in the wheat, but there is so little known as to the location of these proteids in the kernel and the relation that they bear to each other and to gluten that the matter is very indefinite. But it was hoped to ascertain what variation there might be and to throw some light on the matter, if possible. The results show that while the percentage of proteid nitrogen increased from 1.89 to 3.16, the percentage of gliadin plus glutenin nitrogen increased from 1.76 to 2.20. In other words, the increase in the proteid nitrogen content was very much greater in proportion than the increase in the gliadin plus glutenin nitrogen. Therefore the percentage of proteid nitrogen is not a guide in selection for the percentage of gliadin plus glutenin, and if we are selecting for these proteids we must determine them separately. It was further found that as far as the quality of gluten may be determined by the proportion of gliadin to glutenin, that quality remains practically the same as we increase the total per cent of gluten. If the ratio of gliadin to glutenin indicates the quality of the gluten, then in selecting plants of high gluten content we are selecting plants with the same quality of gluten as if we are selecting plants of low gluten content. There would therefore be no danger of plants deterioriating in the quality of gluten if we select plants of high gluten content.

A study of the relation of the nitrogen content of the parent plant to that of the offspring of the first generation showed that the tendency was for the progeny to increase in percentage of nitrogen less rapidly than the mother plants, but in the same way, thus demonstrating that the selection has an effect. This is an important point, because if the kernels of the parent plant were immature or shriveled they would naturally show a higher nitrogen content, and yet we would not expect them to transmit their nitrogen content. If we find, however, that there is a transmission of the nitrogen content we know that it is due to a healthy condition of the plant and is a factor that can be depended upon in improving the wheat in this way.

We found the same tendency toward heredity in the weight of the average kernel that we did in the nitrogen content. In other words, plants of a low weight of kernel tend to produce plants having low kernel weight, and plants of high kernel weight tend to produce plants of higher kernel weight. The variation is not so great as it was with the nitrogen content; still it is consistent, or nearly so, and the hereditary tendency is carried out. We find that wheat varies very greatly in that respect from year to year. The plants, however, maintain their relative standing as to weight of kernel. We have found that in certain years—notably in dry years—the percentage of nitrogen is very high, while the kernels are apt to be small; but in spite of that, the production of nitrogen per acre is generally greater in dry years than in wet years. In other words, the years when we have large crops we do not get as large a production per acre of nitrogen in the grain.

There was a very decided decrease in the yield with the lateness in ripening, and a somewhat marked increase in percentage of proteid nitrogen.

As the yield of grain on the plant increased the height of the plant increased up to a certain point, and then began to decrease; so that the plants of large yield were here plants of medium height. In a similar way the plants that tillered largely were plants having a medium range of yield, and, as regards the weight of the average kernel, the plants of large yield were the plants having a kernel of somewhat more than medium or large weight. So that the best plants appeared to be the plants of average height, and the plants that tillered most were plants of average yield, although data on this point are somewhat limited and do not warrant final conclusions.

Some observations were made on the effect of winterkilling, which showed that there was a constant increase in the yield of the average plant as the number of plants that survived increased. In other words, the effect of the freezing seemed to be to weaken the other plants, or rather, the plants that did survive were injured by the cold, to which they were more susceptible than plants in the families of which a large percentage survived the winter.

H. Snyder, of Minnesota. There are one or two points that were brought out by the figures that perhaps can be mentioned a second time without detriment, and one was that with an increase of nitrogen there was a possibility of a slight decrease in yield. Of course, in taking hold of this question it is highly desirable that yield and quality be combined as far as possible. That is one of the problems that remains yet to be solved along this line. Another question that suggests itself is, Whenever the amount of nitrogen is increased in wheat is it possible for a part of that nitrogen to be stored up in the germ and bran and other parts, rather than in the portion used for flour-making purposes? While in general the increase in the percentage of nitrogen in wheat was followed by an increase of the total gluten, or gliadin and glutenin combined, yet cases are cited in which the total nitrogen was much in excess of gliadin and glutenin, suggesting that in the offal parts a part of this excess of nitrogen was present. So that in taking up the question the object would be to get the nitrogen in the portion that is used for human food rather than in the germ and the offal.

Another point brought out was the necessity of having methods for determining the value, not only of wheat, but cereals in general, where improvement is contemplated. Of course we have individual ideas, but the ideas, perhaps, that would be applicable to one wheat or one cereal would be more a local standard rather than applicable to all conditions; and with that in view I think it would be highly desirable at this time if the association could offer some help. I would therefore move that a committee of three be appointed by the chair to constitute a committee on standards for determining the value of the cereals; the committee not to complete its work in one year, but to be more of a standing committee, so as to have plenty of opportunity and time to take up this work, which would involve a study of the actual value of cereals for human food purposes, their value to the miller for flour-making purposes, their value to the baker for bread-making purposes, and their value to the farmer for cultural purposes. To illustrate further, some of these wheats that have a very high nitrogen content might be the very lightest weight wheats, and if you were to select on nitrogen alone you would get the very lightest weight wheat in the market.

Then, too, the question of flour yield should be considered. In some wheats as high as 76 per cent of the total weight of the wheat is recovered as marketable flour; in others the yield is as low as 46 per cent. It is desirable to get as high a yield of flour as possible and flour of the best quality, and that is the object of this committee—to take this up in a broad way, so that we will have some standards for comparison in this work.

It has been found necessary to combine milling tests with analysis. In our own station we have recently added a complete experimental milling plant with four reduction rollers, so that we can get the yields of all of the different grades of flour and all of the offals. That is quite helpful, as the work, in order to meet with the greatest measure of success possible, requires not only the careful kind of work which Mr. Lyon has done, but must go a step further, getting the flour value, the baking value, and, if necessary, the food value, as well as determining the yield per acre and nitrogen content.

C. E. THORNE, of Ohio. We have been testing a number of varieties of wheat at the Ohio Station. One of these has given us a very high yield, and it has begun to go upon the market. We are hearing from the millers very strong objections to that particular variety of wheat, saying that it is not a good flour-making wheat. The millers are quoting the verdict of a private laboratory which sustains this opinion. This year we sent to that private laboratory some thirty-odd unnamed varieties of wheat, this one among the rest. Notwithstanding the fact that this laboratory had previously given a verdict entirely unfavorable to this particular variety, in the report which came back to us this particular variety ranked second—next to the highest—in milling quality of the many varieties of wheat. Therefore we feel the necessity very urgently and strongly for a test laboratory of the kind mentioned, which shall be of uncontested reputation as an authority, to which we may go for the determination of questions of this sort.

We have been making analyses of wheat for a number of years, and have just lately put together the results. We found for a number of years in succession a steady increase in the amount of nitrogen in the average of the whole until we came to the year 1903, when there was a sudden drop to a point below the lowest of the previous years' record. If we had been making experiments to increase the nitrogen in our wheats we would have felt for a half dozen years that we were securing important results, all to be thrown to the wind in that one year.

C. G. Hopkins, of Illinois. I want to call attention to the fact that Professor Lyon is breeding in two directions, and in that he is independent of seasonal influence. In other words, he is breeding for both high and low protein; so that in a year that produces high-protein wheat both levels are raised, but the difference keeps increasing. We have had the same experience with corn. In our high-protein cornfield, for example, we do not find that the increase is constant; it may rise for three years and then fall and then rise again. Similar fluctuations are also observed with the low-protein corn, but the difference between the two is more constant.

It is of importance in breeding for high protein to maintain a supply of nitrogen in the soil. The supply of nitrogen is just as important in breeding wheat or corn as in breeding animals. The question frequently arises whether growing high-protein corn or wheat does not more rapidly reduce the fertility of the soil. Nitrogen is a peculiar element; it is made available for food as it passes into nitrate form. With this process of nitrification the corn plant or wheat plant has nothing to do. Once in the form of nitrates, so far as we know, the nitrogen is either taken up by crops or it is lost; and the point brought out by Professor Lyon that in the wet seasons the nitrogen content was low may be attributed to the fact that his nitrogen passed off in drainage waters, and was lost to the crop. It would seem, therefore, that the growing of high-protein wheat or high-protein corn is more likely to result in a saving of nitrogen than in any extra draft upon the nitrogen content of the soil. If it is not taken up by the crops it is almost sure to pass off before the next crop is grown.

In reply to a question as to the possibility of judging of the quality of wheat by means of a physical examination, Professor Lyon said: "I suppose that the quality of the wheat is indicated to a considerable extent, at least, by the appearance of the kernel—that is, by its hardness and by the color." Professor Snyder brought out in one of his recent bulletins the difference between the appearance of glutenous wheat and starchy wheat, as shown by the cross-section of a kernel, and I have no doubt that that could be used to a considerable extent as a guide to the quality of wheat in planting.

W. M. Hays, of Minnesota. I am very much struck with the wide variation reported. It is much more than I would expect with the method followed, but dealing with the product of a single mother plant for several generations I would expect to get very much greater variation.

M. A. Scovell, of Kentucky. I am afraid that in the next fifty years scientists will not accept our analyses for proteid compounds any more readily than we accept the analyses of fifty years ago. If we could find out the relation between nitrogen and gluten content, baking qualities, etc., of wheat, the total nitrogen would be the most satisfactory basis of judgment, because it is so easily and accurately determined.

W. Saunders, of Canada. What surprises me very much in this paper is the fact that the composition of the grain from different sides of the same head varies so widely. It shows how very careful we have to be in drawing any conclusions with reference to this subject. Certainly this paper throws a light on the subject that we have never had before.

The motion to appoint a committee on this subject was carried.

The committee, announced later, consists of H. Snyder, of Minnesota; C. G. Hopkins, of Illinois, and T. L. Lyon, of Nebraska.

ANIMAL BREEDING.

C. F. Curtiss, of Iowa, read the following paper on this subject:

"An exact determination of the laws of heredity will probably work more change in man's outlook on the world and his power over nature than any other advance in natural knowledge that can be clearly foreseen."

These are the words of a distinguished scientist who believes that these laws can and will be determined by careful investigation and the tabulation of statistical results indicating the course of heredity under different conditions. That there has been a great awakening of interest in the principles of breeding plants and animals and in biological problems is plainly apparent. This search for the truth concerning the laws of life is tersely put by Pearson in the following paragraph:

"There is an insatiable desire in the human breast to resume in some short formula, some brief statement, the facts of human experience. It leads the savage to 'account' for all natural phenomena by deifying the wind, and the stream, and the tree. It leads civilized man, on the other hand, to express his emotional experience in works of art, and his physical and mental experience in the formulæ or so-called laws of science."

The recent investigations in this field have related chiefly to plant breeding. The plant breeders have given us the first mathematical formulas for measuring the forces of heredity. While it is not certain that these formulas are of general application and many investigators are not willing to accept them at all, they have attracted wide attention and stimulated inquiry.

This activity on the part of plant breeders has invaded the field of animal breeders. Some valuable work has been done in recent years, and the future gives promise of the inauguration of extensive investigations that will undoubtedly throw much light on our knowledge of the laws of animal breeding.

The creative and deductive work of such men as Burbank, Ewart, De Vries, Vilmorin, Galton, and Mendel have been a great incentive to scientific and practical investigation.

The lack of means, equipment, and time required for study and inquiry in this field has thus far prevented the experiment stations in the various States from undertaking much of this work. Many of the stations are now preparing to establish work in animal breeding, however, and some few already have work in progress. The American Breeders' Association was organized in St. Louis in December, 1903, and now has about 20 life members and 300 annual members, some of whom are enrolled from foreign countries. It is the purpose of this organization to afford opportunity for discussion and comparison of methods, principles, and results from the work of the leading authorities on plant and animal breeding of all countries.

The last Congress made an appropriation of $25,000 for cooperative breeding and feeding work under the direction of the Secretary of Agriculture, and cooperative work has already been inaugurated by the Bureau of Animal Industry in several of the stations, the most notable being that in Colorado for the purpose of producing a heavy harness or coach horse type by the use of the American trotting horse as foundation stock. The excellence of some of the best specimens of trotting-bred horses for this purpose and the importance of and demand for superior horses of this type renders this a work of great interest and far-reaching consequences.

I have recently addressed inquiries to about twenty of the experiment stations giving most attention to animal husbandry, asking the nature of the animal breeding work they have in progress or plans under contemplation for inauguration of this work in the future. From the stations having work in progress I have the following replies:

By Prof. E. R. Lloyd, of Mississippi: "We have done no really scientific work in animal breeding, but our efforts have been directed mainly along the line of improving the native 'scrub' cattle of the State, as regards their beef form and feeding qualities. I will briefly outline what we have attempted and give some of the results accomplished.

"Our foundation herd was composed of 25 native cows of no fixed type or breeding, with perhaps Jersey blood predominating. An Angus bull of good beef form was used on this herd. We now have 50 animals in the herd, ranging from one-half to seven-eighths Angus blood. A rigid selection has been made each year, retaining in the herd only those animals that approach nearest the type we want. From the half-blood calves 98 per cent are hornless and 95 per cent solid black. The foundation herd of native cows were all colors, and all except four had horns. The form and feeding quality of the calves has been much improved and their market value increased. Our grade Angus calves will sell readily for one-third more than the native calves of same age. Our calves are larger at same age and many of them look like pure-bred Angus. Our grade steers of 2 and 3 years old will bring from one-half to 1 per cent more per pound on foot than native steers or same age and size. We are this year establishing some work with Shorthorn bulls on native cows.

"We have not as yet gone far enough into the feeding or finishing of these grade steers to be able to make a report of that side of the work. We have in progress comparative feeding of native and grade steers, and this work will continue for some time yet. We have graded up a bunch of sheep by using Dorset bucks on native ewes. The native ewes give an average clip of 2.9 pounds of wool, and only about 5 per cent dropped twin lambs. Our flock now averages 5 pounds of wool, and 50 per cent brought twin lambs last season.

"I hope you may be able to form some idea of our work from this brief statement. Our farmers are taking great interest in better cattle, especially beef cattle. Our station inoculated over 300 registered cattle for farmers last season."

By Prof. J. H. Skinner, of Indiana: "At present we are conducting some experiments in swine breeding. As you are aware, there has been much discussion as to the use of bacon hogs, especially to bring in renewed vitality and increase of prolificacy of other breeds. We have undertaken to investigate the matter of crossing Poland Chinas on Yorkshires, selecting the females which have a tendency toward bacon type from each generation and using pure-bred Poland China males to mate with these sows. The work has been in progress two years. We are not in position, however, to make any statements in regard to results, as I believe such experiments should be carefully worked out and sufficient data secured before drawing any conclusions."

By Prof. R. S. Shaw, of Michigan: "At present we have the necessary facilities about complete for launching out on an extensive line of breeding in which the grade dairy cow is to be the subject used. One of our men is at present in the field purchasing 20 high-grade Shorthorn cows. These are to be brought to the institution and a record made regarding the age, weight, form, quality, etc., of each individual, each record to be accompanied by a photograph. The cows will then be divided into 4 uniform lots. The females of lot 1 and their female offspring will be bred to a continuous line of Holstein bulls; lot 2 to Jersey bulls; lot 3 to Guernsey bulls, and lot 4 to dual purpose Shorthorn bulls. The idea is to keep a record of each generation of females as dairy producers and to determine the veal or baby beef values of the male offspring. The primary object of this work will be to demonstrate the possibilities of improving common-grade stock through upgrading. The secondary object will be to demonstrate what good feeding, care, and management will do to increase the productiveness of the original stocks chosen. The indiscriminate admixtures of blood in breeding dairy cows has led to this line of work.

"One year ago we started some investigations in breeding in relation to size in dairy cows. For example, in purchasing Ayrshire cows we found it almost impossible to secure cows possessed of the size which the breed manifested ten to fifteen years ago. Two Ayrshire cows were purchased which at thirty-seven months of age had produced two calves each; neither cow weighing to exceed 700 pounds. A lifetime record of these two cows, in addition to several of other breeds, is to be kept. It is the intention to so breed and handle the female offspring as to produce larger individuals conforming more nearly to the original type, and then secure, as far as possible, comparative data relative to the two types.

"We have no definite plans as yet relative to breeding problems among beef cattle. Our swine department is being adjusted as rapidly as possible so as to enable us to begin original investigation work in swine breeding. Up to the present we have simply produced several crosses in order to study more carefully those types occupying a place midway between extreme lard and bacon types. During the past two years sheep and swine feeding investigations have been conducted here quite extensively."

By Prof. C. S. Plumb, of Ohio: "It seems to me some experiments might be conducted systematically, dealing with telegony, cross breeding, in-and-in breeding, fecundity, and some other subjects in which little has yet been attempted. This work will necessarily cover considerable time and may involve various kinds of animals, but it is clear in my mind that it should be done. There are two good reasons for this work: One, to secure definite knowledge on some things involving the principles of breeding; the other to furnish scientific aid to farm practice, such as relates to methods of breeding, and in its application to such things as fecundity, prepotency, etc.

"The cooperative feature of breeding work can be made very useful, but it will have to be worked into, it seems to me, gradually, with the station also checking up, if possible, in the same line of investigation."

By Prof. James W. Wilson, of South Dakota: "I am starting a new breed of hogs. I think there is a demand in this State for a lard breed more prolific and with greater fecundity than the Duroc Jerseys or Poland Chinas. We are carrying on an experiment with sheep. It is our intention to include the six leading breeds of sheep and ewes of common range breeding. We will breed ten head of each each year to each of these rams, rotating the rams each year and using the same ewes, fattening the lambs off at 1 year old, which experiment will give us some idea of the best breed of sheep to use for our conditions. A similar experiment with cattle is now under way."

By Prof. Andrew Boss, of Minnesota: "The line of work that I have most completely in mind is that of founding breeds that have the intrinsic qualities demanded by the market. In view of this I have been selecting certain families of hogs that conform to the market demands and recording their breeding, and in most cases working out the good qualities of the litters when fatted. This, however, has given us only the most meager kind of a foundation for good work in the future. As soon as we learn the value and characteristics of the foundation stock on hand it will be our object to fasten, if possible, the characteristics of the breed either by cross breeding, inbreeding, or whatever other method we may find satisfactory.

"I believe that in order to get good results we must know just exactly what the individuals are worth that we are working with, and that we must have definite knowledge as to the best means of propagating their usefulness.

"My ideas in regard to the problems in animal breeding are not so extensive, possibly, as some other people may have. As I see it the problems must be solved by large moneyed interests. Results come so slowly in animal breeding that one individual is not able to accomplish very much in the way of permanent results. I believe the colleges and stations could do a great work in this line if they were organized into a cooperative association, and select for director of the work some man or a committee of men who are well up in the subject, and who would give promise of long service. The institutions could also work with the individual breeders, but it is so hard to control conditions there, or rather to control the inclinations of the individual breeders, that I believe better results would be obtained under experiment station management.

"I have no outline to submit of any plan of work with the colleges and experiment stations. My individual plan for animal breeding in experiments is not on a basis that would be of value to such an organization. They include simply the measuring of individuals for foundation work and of further testing the value of these animals by measuring the value of the offspring. When these facts have been learned, then comes a plan for fixing the qualities, or possibly developing a new breed."

By Prof. F. B. Mumford, of Missouri: "In my opinion the greatest need in animal breeding at the present time is for experimental data secured by painstaking, accurate research, which will help us to decide with much more definiteness upon some of the questions which are now largely matters of opinion. This opinion, I think, is held by the leading biologists of this and other countries.

"The investigations in this subject by the stations should, it seems to me, contribute to the upbuilding of the science of breeding. Following this suggestion to its logical conclusion means long and laborious experimentation, using large numbers of animals. The expense of this work with farm animals, and the small number of individuals, makes it difficult or impossible to carry on this work with such animals. It will be necessary to investigate many of these questions by the use of small animals that breed rapidly.

"Another line of experiments which are of the greatest practical value to breeders is an investigation of the influence of environment, including exercise, feed, shelter, etc., on the breeding efficiency of animals. There are great possibilities in this latter work. This does not by any means exhaust the possibilities of research in animal breeding."

By Prof. W. R. Dodson, of Louisiana: "As you know, we have been working for several years on the immunization of northern cattle to the Texas fever. We now have on hand a small herd, consisting of nine mothers, grade Angus, purchased nearly three years ago in Clinton, Ill., immunized at Baton Rouge, and bred to a registered Angus bull purchased at the same place at the same time. All of these heifers have calves that have passed through the summer, and all have been heavily infested with ticks. Two of the cows have a second calf, and all of them will have their second calf this winter. We have ten head of grade Hereford calves, raised on the station. The oldest one of these will have a calf about February; several others will come in about May. These animals will compare favorably with any to be found on the farms of Illinois, Missouri, or elsewhere outside of the barns of the fancy breeder. Of course, you are aware that our native cattle all have the fever when they are calves, as has been brought out by our work, and while the disease to a considerable extent retards the development of the animal, as soon as the ticks are removed the animal soon begins to recover from the effects; and if the ticks are not allowed to become excessively abundant the animal thrives apparently as well as in the North. Our calves running on the pasture are as fat from the latter part of April to the latter part of October as they are in the blue-grass section. We have also demonstrated that it is possible to rid our pastures of ticks. This, of course, puts a different future before the stockman of the South. Though it will be more trouble, and require greater vigilance, I see no reason why the intelligent and industrious farmer of the South should not equal or excel the northern man in the production of beef and milch cattle.

"We are not doing anything with other lines of animal breeding. I might remind you of the fact that we topped the market at Chicago with some beef steers purchased as calves in Illinois, immunized in Louisiana, fattened after having been there two years, and reshipped to Chicago."

By Prof. E. W. Major, of California: "The live-stock work here has been started such a short time that we have not had opportunity to carry on any breeding experiments so far. At present I am purchasing some hogs. Shall have some Berkshires, Poland Chinas, and Tamworths, and shall try some experiments with these. I am rather looking to see if we can not find a hog that will do better in the alfalfa sections than the Poland Chinas. These experiments will be largely along the line of feeding, but I expect to do some at the present time in cross breeding. We intend to do some experimenting right away in poultry breeding.

"In regard to suggestions, the one that appeals to me most forcibly is this: If experiment station workers would start a discussion, it would have to be done by correspondence, in regard to the data to be recorded in breeding experiments. Those of us who are situated so far from the center, and therefore are unable to attend many meetings, have little opportunity of discussing the question with other experiment station men and getting in touch with the work they are doing."

Aside from this, the work largely done at several of the stations is familiar to the members of this body. The work of the Wisconsin Experiment Station in crossing and grading unimproved types of sheep has given striking results that have been of practical and scientific value. The provisions for the investigations of Professor Davenport at the newly equipped laboratory under the auspices of the Carnegié Institute is significant of the growing interest in this field of inquiry, and the results of these investigations will be looked forward to with unusual interest.

At the Iowa station several lines of animal-breeding work are in progress. It is well known that we have no breed of sheep in America adapted to the range conditions and meeting the requirements of the range in any adequate manner. Sheep raisers in the range territory resort to frequent crossing, alternating from the Merino to the coarse-wooled mutton breeds for compactness of fleece, ability to graze in large numbers, size, length of staple, and then to the Down breeds for improvement of mutton qualities. It is necessary to make frequent changes in the use of these types, and there is a lack of uniformity and stability in breed characteristics and qualities desired for range conditions.

We have taken up work in crossing these types with a view to gradually evolving something that will meet the requirements of range conditions and that may be fixed and perpetuated. This work has been in progress during the past three years, but has not yet advanced far enough to reach definite results.

In 1900 the Union Stockyard and Transit Company of Chicago furnished funds for the inauguration of some breeding and feeding experiments known as the production of "Blue-Gray" cattle, by the use of white Shorthorn sire on grade and pure bred Galloway females. We have already produced two crops of calves and the third is due this fall. The first crop is now coming two years old, and they are being finished for market and for the International Live Stock Exposition at Chicago, and some interesting and rather striking results have been attained. The superior reputation of these cattle as feeding bullocks has been fully confirmed. They are not, however, quite as even in their flesh and as smooth and uniform in their carcass in all cases as the modern market demands. We hope to introduce some new features in this work during the coming year by selecting ten of the best Galloway cows, which have during the past two seasons been bred to a white Shorthorn bull, to be bred during the coming year to a pure-bred Galloway, thus giving opportunity to test the theory of "telegony." It is also proposed to select ten white Shorthorn females and breed to a pure-bred Galloway bull, thus reversing the process of producing Blue-Grays. Then, before we terminate the experiment, we shall do some breeding with a view to fixing the Blue-Gray characteristics and endeavor to perpetuate type. We are well aware that this may be a difficult process, but it is the intention to conduct some investigations along this line.

During the progress of this work an interesting and unexpected result was obtained in the fact that the second crop of calves from the same cows and by the same sire were not as uniform and as well colored as the first lot. There is no means of accounting for this departure from the Blue-Gray color in the greater number of instances in the second than in the first mating. It is believed by many of our best breeders that subsequent offspring by the same sire and from the same females will be more uniform in type and color and characteristics than the first offspring.

We have also planned to cross two breeds of hogs, using, perhaps, the Berkshire and Tamworth, with the sire of one breed in a given number of cases and the sire of the other breed in an equal number of cases. Perhaps five or ten sires of each breed will be used and the work repeated several times. One object of this will be to determine the relative influence of the sire and dam in crossing distinct types. Some of these sows will then be bred back to sires of the same breed, to test the theory of telegony in breeding hogs.

In some work of this kind which has already been carried on during two seasons it has seemed in crossing the Tamworth and Poland China that the dam exerted the greater influence. When the Poland China sire was used on the Tamworth dam the offspring had more of the Tamworth than when the Tamworth sire was used on the Poland China dam.

I believe that many of the theories and supposed laws of heredity should be tested by extensive and repeated experiments with domestic animals, and that it is desirable that this work be done with the larger rather than the smaller animals, notwithstanding the fact that it will take a much longer time and involve a greater expenditure. The work of Prof. Cossar Ewart in crossing the horse and zebra, breeding back again to the original types, for the purpose of testing the theory of telegony, has perhaps done more to establish conclusive results concerning this one theory than all the previous investigations combined. Professor Ewart's conclusions, however, are applied only to horses and dogs, and he expresses no opinion concerning their application to other kinds of domestic animals. Some of our plant breeders have obtained results which tend quite conclusively to substantiate the Mendel law theory. Others have obtained results quite the contrary. No one has yet endeavored to test the application of this law to the breeding of the higher domestic animals. I am told that one of our most extensive and successful dealers in heavy harness horses of trotting blood has made the statement that his experience, extending over a number of years and applying to many thousands of horses, selected with the utmost care from perhaps hundreds of thousands that have been inspected, has shown conclusively that 95 per cent of the horses conforming to this type in conformation, action, quality, and other characteristics that go to make up the essential standard, may be traced directly to two sires. This man speaks with considerable authority, as he has for years made it a practice to keep a complete record, including the breeding, of each horse that has passed through his stables. Possibly if these results were carefully investigated they might establish a case of Mendelian dominance.

The brief reports which are here submitted relative to the work now in progress in the several stations and the plans under consideration for the extension of this work, indicate clearly that this field of investigation, which has until recently been almost entirely neglected by the experiment stations, through various causes for which they have not been responsible, is soon to become one of the most interesting and profitable lines of investigation.

H. E. Summers, of Iowa. I may say that certain animals, including the cavies, for instance, which have been investigated quite extensively, have been found in certain characteristics, viz, color, condition of albinism, and length of hair, to conform absolutely to Mendel's law. I have myself a litter of four white cavies only two days old, from a white and colored mother, in which the probabilities under any other conditions than the Mendelian law would be almost too great to be conceived of. This is simply one illustration, and of course would not prove the law, but it agrees with some thousands of experiments which have shown that the law applies.

W. M. Hays, of Minnesota. Whether these conflicting reports are really conflicting or based on experiments that really give the true comparison as to the operation of the Mendelian law, I can cite the following case: An experimenter in England, I understand, worked on the color of some animals and found that it did not follow the Mendelian law, but he afterwards found that there were three component colors in that compound color, and when taken separately they did follow the Mendelian law, and that these were the unit characters while the component color was a variable character. Practically a parallel case was found in the orchid grown by some English experimenter, in which the component colors operated in accordance with the Mendelian idea, whereas the blended color had not so operated. Experiments must first be made along the line of finding whether the characteristic in question is a dominant or unit character.

N. S. Mayo, of Cuba, spoke briefly of that country as a field for the breeding and adaptation of animals.

W. M. Hays. In the recent breeding school at St. Louis Doctor Cary, of Alabama, brought out the fact that he thought it might be possible to breed immunity to Texas fever in the southern belt, and that then quarantine methods might be used to gradually push the tick out of that country. Experiments have also been suggested along the line of breeding for at least comparative immunity from tuberculosis in cattle, thus lessening tuberculosis in man to some extent; also the possibility of breeding for comparative immunity to swine plague in hogs. Some of the smaller animals can be used, no doubt, to illustrate whether immunity can be reached by this method; for instance, rabbits are very subject to tuberculosis and they might be used in a preliminary experiment. Experiments are now being successfully made in the breeding of plants immune to disease. Professor Bolley has recently produced very pronounced results on flax. At the school in St. Louis Professor Bolley brought out with very great force the idea that if you want to breed for immunity the disease must be present in great quantity. Of course that is true of all breeding. We must breed as nearly as we can under the extreme conditions we wish the final product to withstand.

The committee on nominations reported as follows:

For members of executive committee, W. H. Jordan, of New York; C. F. Curtiss, of Iowa; for chairman of section, H. J. Patterson, of Maryland; for secretary of section, M. A. Scovell, of Kentucky; for additional members of committee on programme, C. D. Woods, of Maine, J. F. Duggar, of Alabama.

The secretary was instructed to cast the ballot of the section in favor of the persons so nominated.

EVENING SESSION, WEDNESDAY, NOVEMBER 2, 1904.

The section was called to order at 9.30 p. m. by Chairman Jenkins, who announced the subject for discussion to be:

HOW MUCH TEACHING, IF ANY, IS IT DESIRABLE THAT A STATION WORKER SHOULD DO?

H. P. ARMSBY, of Pennsylvania. We are all familiar with the history of the establishment of the experiment stations and with the very natural way in which they were manned from the teaching force of the colleges, the time of the instructor being divided between the college and the station. This method of procedure was very natural and perhaps unavoidable at that time, and the practice has continued up to the present. During the last year for which statistics have been published by the Office of Experiment Stations about 54 per cent of the station workers did more or less teaching. Of course such figures are somewhat misleading since they give simply the number of individuals without reference to the amount of work done, but they at least show that a very considerable proportion of the workers in the stations are also teachers. The proportion of course varies a good deal in the different stations. In some stations—one or two—all members of the force are stated to have more or less teaching work, and the proportion ranges from 100 per cent in these cases down to a minimum of about 5½ per cent. The second largest is 89 per cent, and the second smallest about 15½ per cent.

Moreover, the tendency seems to be toward an increase in the number of the station men who are also doing teaching work. In the year ended June 30, 1897—the earliest for which I could readily find figures—the percentage of station workers who were also teachers, excluding in this computation the independent stations of Connecticut, New York, Georgia, and Ohio, was 49.3, and for succeeding years up to 1903 the figures run in round numbers 49, 50, 50, 52, 52, 56, and 54, showing quite a plain tendency toward an increase in the proportion of station workers who teach.

Most of you will probably recall the address of Director Jordan at the New Haven convention, in which he called attention to the fact that in that year a very large proportion of the heads of departments in stations were also teachers, so that the teaching work was laid upon the higher officers of the stations rather than upon the lower grade assistants. I think that would probably be equally true—perhaps more true—now. The fact of the matter is that the recent growth of instruction in agriculture—the differentiation of agricultural instruction—has had a tendency to increase the demands upon the station specialist for teaching.

I think we all agree that it is an important question of station administration as to how far this tendency is wise and desirable. Some, for whose opinion upon such matters I have the very highest respect, urge very strongly that it is desirable, in most cases, at least, that the experiment station worker shall also be a teacher, and the teacher shall also be an investigator. They claim that the two kinds of work are mutually helpful to each other. I am not clear that I agree with that opinion, however. But this is too important a question for our opinions or convictions to be settled subjectively by our own personal impressions, and the thought that was really in my mind in suggesting this topic for discussion was whether we could not profitably get together and compare our views upon it. Of course the figures which I have presented are merely suggestive; they probably do not represent quantitatively the situation, because, doubtless, many of the men included in the estimate had comparatively little teaching, but they do serve to suggest the importance of the question and the need for comparing views upon it.

W. H. Jordan, of New York. If I could have the heads of the departments of the New York State Station give a few lectures (from ten to twenty) a year I would be glad to have them do it as a means of clarifying their views, looking up literature, and that sort of thing. It makes a difference what kind of teaching a station worker does as to whether it is an advantage to him or not. The most of the teaching done by college and station men in this country is the teaching of fundamentals, and I believe it is nothing but a pleasant fallacy on the part of those who wish to reenforce their teaching staff to maintain that teaching the fundamentals and the drilling of classes for 50 per cent of the time is an advantage to the investigator. I do not believe any such thing. I believe in the differentiation of functions. What kind of a man do you want for an investigator? A man absorbed in the things he is doing and who shall not be turned aside and wearied by having to drill a class or do anything else but hunt his subject and the truth. You know that teaching has to be done at stated times, and the investigation must wait till the convenient day. That is exactly what happens in actual practice. My answer to the question would therefore be: A small amount of teaching of an advanced character along the line of the specialties with which the station man is engaged and on which he is thinking is all right. However, very much of teaching which we necessarily do in our agricultural colleges to-day is not an advantage, but a disadvantage to the investigator.

C. D. Smith, of Michigan. I do not object so much to a subordinate doing the teaching as I do the head of the department, for the reason that if the head of a department of the station has also the management of a large teaching department of the college he can no longer do very good station work. The danger is, as experience has shown, that the demands of the teaching will gradually encroach upon and crowd out the research work. The investigator should be almost, if not quite, entirely free from the teaching work. My experience has led me to believe most emphatically that we are not going to get the results that we should get from the stations until this is done. The differentiation between the teaching and investigation must be complete.

C. D. Woods, of Maine. I think it is easy for us to see the way we have come into the present position. When the stations were first established comparatively few skilled men were obtainable. The stations started out on the plan of the college, with a great many departments in charge of young men who had their reputations to make. The result has been that we very materially increased the station pay roll until it reached a point where it was impossible for the station alone to keep all the men required and give them the amount of money they ought to have or could get elsewhere. So it has come about that this division of men between the station and the college has perhaps increased in the later years. With a small increase of appropriation for the station it would be possible to solve this problem, and in the effort to do this I think we will have the help of the college men.

I thoroughly believe that a station man ought not to be a dual man. I wish that in our own experiment station we did not have a single man connected with the station who had routine instruction to do. Advanced instruction a few hours in the course of the year, requiring the preparation of ten, twelve, or twenty lectures for the students, would, in my opinion, be helpful, but any drudgery of teaching for a station officer I am very sure is a detriment to the station work.

C. F. Curtiss, of Iowa. I believe that the stations in many instances, and even, I will say, a majority of instances, are approaching a better basis of adjustment of the work between the college and the station. I do not think that we can readily or in the near future attain a position where we can entirely divorce the college and station work in the heads of departments. I believe that the head of the department ought to direct the investigation work along his line at least in an advisory way, even though he does not devote any of his time to the details of that work or to the management of it. I think if he is a teacher and giving his time to the college side of the work he ought to give enough of his time to the station work to direct its course.

I am entirely convinced of the desirability of investigators doing investigating work alone or exclusively, so largely as it may be possible, and I think that the tendency generally is toward a better adjustment. In our own station, for instance, we have now established the work of two departments on such a basis that the men in charge of the station work give no instruction except to graduate students. These men will devote their time exclusively to the research and experiment station work, except in case of graduate students that may elect to take work in that department. In other departments we have an arrangement by which the head of the department is considered and regarded as primarily a college man, and receives the greater part—practically all—of his salary from the college, and has assistants who receive their salary altogether from the station, devoting their time altogether to station work. I think, as was suggested by Director Woods, that when the stations have more means to devote to this work they will be able to employ men exclusively for research work, and those men will of course be under the direction of the head of the department. So that gradually, as we enlarge our work and as we are able to provide better facilities for it, we are arriving at a better basis, although there is still very much to be done in the adjustment of work.

N. S. MAYO. It seems to me that this subject has been treated so far entirely from the standpoint of the station investigator pure and simple. There is a phase of the work that I have found of an advantage in dealing with the more elementary students in classes, and that is the training which it gives to the worker in bringing his scientific work to the level of the common man, and I believe this is an important training. A good portion of our work is for the common farmer, and it is important that we should bring it to his level, and I believe that in bringing our work to the elementary classes we do get a valuable training along that line. The greatest obstacle that I have found in teaching is the amount of energy which it necessarily requires. Two or three hours of teaching as it ought to be done detracts very materially from the energy a man can put into his investigation work.

L. G. CARPENTER, of Colorado. I suppose we can all imagine the ideal condition, but I presume none of us has yet attained it. We nearly all suffer from limitations, both from place and finances. I am not at all sure, however, that the stations as a whole have suffered by the connection with the colleges. If we look at the work of an individual we may see in a great many cases that he could do more and perhaps better work if he were disassociated from teaching. On the other hand, we have an aggregate to consider in some cases. I know that in some of the stations, as in the one with which I am connected, the aid from the colleges has been material and liberal, and has made possible the maintenance of a large number of departments that are giving more or less attention to investigation. There are undoubtedly some disadvantages in connection with the teaching. One of the greatest is, I think, the fact that the investigation has to give way to routine hours; investigation does not come at regular times. A person can not do the highest kind of work for many hours a day. To do productive and creative work, which is the best part of his work as an investigator, a person must devote himself to it for only a short time and when he is in the freshest condition. Almost any kind of routine work does interfere with that, and to some extent teaching will so interfere, certainly if carried on to any great extent. It interferes with the continuity of thought, and the hours of teaching may interfere even with the whole day's work by the breaking up of the lines of thought or the continuity of investigation. Outside of that I am not at all sure that the teaching does not have a good many advantages.

I am inclined to believe that the investigator should do less teaching, but that the teaching should be under the direction of the investigation staff rather than the reverse. I am at present far from believing that it is wise to separate college and station, if it were possible. I do not believe that a staff worker ought to do much teaching, but as to whether the teaching he does should be that given to the higher students or to elementary students I am not quite clear, although I recognize the force of what has been said about the advantages of the instruction of the higher classes. The station workers should have a training which will enable them to express the results of their investigations in a clear way to the public. I am fully aware that there are a great many exceedingly valuable investigators who do not have that faculty and do not care to go before the public in any capacity. We recognize their value, and a great many times it is best to recognize that peculiarity of their make-up and allow them to confine themselves to investigation. On the other hand, there are a great many men who can do both, and probably the majority have to some extent the willingness and the ability to do both. To those people who do not have that particular trend, the dealing with elementary students or the attempt to put the subject in an elementary way, it seems to me, is a very valuable training, but ought to be done with limitations.

F. B. Mumford, of Missouri. It seems to me it has been clearly demonstrated by several of the speakers that it depends a good deal on the viewpoint from which we consider this question. The University of Missouri may be differently situated from some of the colleges and stations referred to, but so far as we are concerned we find it to the advantage of the station from almost every standpoint that the teachers who are there engaged are not only permitted but required to devote some of their time to station work. Let me give a concrete illustration. The university has in the course of its search for men in the departments secured a man who is eminent for his research work in a given line, and that line of work happens to be closely associated with agricultural college and station work. His salary is paid entirely by the university, and he has from his own choice and by the permission of the university devoted considerable time to research for the station, the station paying the expenses of the investigation. I suppose that it would be impossible for the station ever to be able to secure the services of such a man were they compelled to pay him his entire salary, but working in this way we are able to secure the advantages of his investigation. There are a number of men of this kind in our institution who are working in the same way.

J. L. Hills, of Vermont. In the smaller institutions, where funds are comparatively limited, the dual duty must needs be met. I think you will pardon me if I tell you how at the University of Vermont we have endeavored to meet these conditions.

In my own case I try for what we term our first half year to lay almost all the stress upon college work. I have arranged with my associates in the faculty for several of them to lay almost all their teaching stress on the second half year. From October 1 to February 1, except for the routine of work which must be done, I put my energies just so far as I can into college work. After February 1 I devote my energies to the administration of the station and to experimental work. On the other hand, other of the instructors in our faculty beginning with the second half of the year lay particular stress on the college work, and in that way we are enabled to do, perhaps, rather more justice to the dual duties than in any other way. I do not think this method is applicable to all institutions, but it has worked fairly well with us.

W. L. Carlyle, of Colorado. I think we are all agreed that from the standpoint of the investigator too much teaching is not advisable, but from the standpoint of the teacher some station work is certainly advisable, particularly in the more industrial parts of our agricultural work. The man who is going to do effective teaching for a period of years in animal husbandry, for example, must be an investigator. If we take the investigation work away from our teachers we are going to greatly lessen the effectiveness of the teaching. It seems to me this is not so much a matter of amount of investigation as of subjects. Certain subjects require practically all of a man's time and attention in the investigational work; others are not so exacting, and those are perhaps the ones which require a certain amount of investigational work to make the teaching the more effective. Speaking from the standpoint of one who has to investigate and teach at the same time, I think it would be a misfortune, in some of the subjects particularly, if the station work and the teaching should be divorced.

H. P. Armsby, of Pennsylvania. I think we all recognize the fact that we can not at once adopt any uniform arrangement in this matter. But I take it what we need especially to consider at the present time is not so much the question of practicability as the question of ideals. It is a question of the attitude of mind of the authorities of these institutions toward this question; it is a question of the ultimate ideal that they will set before themselves to attain, and if that ideal is not any higher than that already reached we shall not make much progress. Personally I believe it is just as true now as it was two thousand years ago that no man can serve two masters. I believe that in this agricultural work a man should be chiefly either one thing or the other. I will not say that he should be exclusively either a teacher or an investigator, but it seems to me that the two kinds of work call for a different attitude of mind and the use of a different set of faculties, to a certain extent, and that except in the case of unusually gifted men the same individual is not likely to have both equally developed. I feel that an investigator and station worker should have his mind focused on his work of investigation. On the other hand, it seems to me that the teacher's thought should be pedagogical largely; it should be that side of his mind that is particularly active. I will admit that a certain amount of teaching may be advantageous to station work, but an uncertain amount is not. I think that some teaching, especially more or less advanced teaching, is a good thing, as has been said repeatedly. Possibly it need not even be the most advanced teaching. I do not think, however, that a station worker, even though he does some teaching, should have loaded upon him the responsibility for the administration of the teaching work of the college, or any considerable amount of it. I think he should simply go into his class room and give his lectures or his instruction, and be done with it.

On the other hand, it seems to me that the teacher may very well do more or less investigational work, according to his taste and capacity. I would not for a moment cut him off from that, but I believe he should be thinking chiefly of his teaching and should make his work of investigation his avocation rather than his vocation.

I repeat that this is a question of ideals rather than of immediate adjustment. It is not a question of division of salaries. I think we may assume that that question has been pretty well worked out, and that so far as the mere question of adjustment of time is concerned the attempt has been to establish equity as between the college and the station; but I believe it is also true that in this matter two and two do not always make four. I am very sure that two half men are not anywhere near equal to one whole man, and, going still further, I think that four quarter men are worth very little.

I am very much gratified at the interest which has been manifested and the spirit in which this subject has been discussed. I believe it is a live subject. I believe that it is imperative now, if this experiment-station enterprise is to reach large success, that there should be a reform; that the tendency should be in the other direction from what it now appears to be; that the sentiment and policy of these institutions should be, as rapidly as conditions will allow, to differentiate between the station and the school or college of agriculture, and to have just what the Hatch Act calls for—a department of the college devoted to research. We should work toward that just as fast as we can if we desire this experiment-station enterprise to succeed, and I believe it is especially timely to consider this now, in view of the hope that we have of an increase in the station funds. If that comes, I believe the directors all over the country should know that their colleagues will support them in an endeavor to secure a more clean-cut organization of the experiment stations as distinct departments of research.

W. J. **Fraser**, of Illinois. It seems to me it is of greater importance to have the subdivision of the subject more minute than it is, to decide as to whether a man is going to devote the most of his time to experiment-station or to college work. In the dairy department of the University of Illinois there are two of us that are giving all of our time to dairy cattle—one to the subject of milk and another to the subject of butter. In the animal husbandry department one man devotes all of his time to swine, and I think he has done better work the past year than if he were working either in the college or station in the whole subject of animal husbandry. It seems to me that one of the best ways out of the difficulty is to divide the subjects more minutely and have a man get nearer to the bottom of his subject, both in the station and the college. I will say, however, that the heads of departments in our institution do very little teaching, but spend most of their time in investigation work.

F. B. **Linfield**, of Montana. There has been within the past few years a very great increase in the number of men employed in the agricultural colleges and experiment stations, and I believe that there are more men who are devoting their whole time to investigation at the present time than ever before. The tendency seems to be in the right direction. Without a certain amount of help from the station it is probable that in a great many cases the college would have to cut off some of its departments; at the same time, without some help from the other side, it is probable that that station would have to cut off several of its departments. Some will say that is advisable. There are conditions, however, in which that would not be advisable, and the college and station may be mutually helpful. It is a good thing for an investigator to do a little teaching; that has been conceded. I think there is a great deal in the thought that a good teacher must be an investigator, whether he does the work under the direction of an experiment station or in some other way. How is the teacher or the investigator to do the best work in this dual capacity? The plan which I have thought about is the one suggested by Director Hills. In this division of the agricultural field, which at present is going on so rapidly, such a division of labor from one part of the year to another is a very easy possibility.

H. P. **Armsby**. I have hastily computed the relative increase in the teachers and the nonteachers on the station force, as shown by the official statistics of the Office of Experiment Stations. From 1897 to 1903 there was an increase in the nonteachers of 9 per cent and in the teachers of 32 per cent.

H. J. Wheeler, of Rhode Island. It seems to me there is perhaps some confusion in the minds of those who have spoken as to what is strictly investigation. If a man plants some potatoes and observes their form and shape and writes up the result, he can perhaps do some teaching and do that sort of work, too; but if he has to deal with some difficult problem, which requires him to make an exhaustive search of the literature of the subject, to conduct investigations which perhaps run over five or six years, and to thoroughly digest the results, he can not do it to good advantage if during that time he is obliged to go into the class room and teach at irregular hours. There may be some so-called investigation work which can be combined with teaching without very much loss.

I know of no better practice that a man can get than by going out to a farmers' institute, and I think it is a very good thing for the station worker to get out and lecture half a dozen times a year. I believe, moreover, that it is a good thing for a man to present the advanced work that he is doing to students. I think, however, that the student derives a great deal more from it than the investigator does, because there is no man who can lead a student right up to the border between the known and unknown as the investigator can. I have never seen a man devoting more than half of his time to teaching who has done work which was fully satisfactory to the experiment station. There may be extreme instances in which a man has been able to do it.

I have repeatedly heard it said that the German investigators, who are the greatest in the world, do a large amount of teaching, but the German professors who have won the greatest distinction are not teachers, but investigators who have done very little teaching. So, if there is anything in example and precedent to be won from the best scientific minds in the world, it is along that line. It is not the man who spends three-fourths of his time, or six or seven hours a week right along, in teaching who can be expected to win a reputation as an investigator.

H. P. Armsby. The German professor, moreover, does not have to teach unless he wishes to.

Upon motion the section adjourned.

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THE AGRICULTURAL EXPERIMENT STATIONS.

- Alabama—
  - College Station: *Auburn;* J. F. Duggar.[a]
  - Canebrake Station: *Uniontown;* J. M. Richeson.[b]
  - Tuskegee Station: *Tuskegee;* G. W. Carver.[a]
- Alaska—*Sitka:* C. C. Georgeson.[c]
- Arizona—*Tucson:* R. H. Forbes.[a]
- Arkansas—*Fayetteville:* W. G. Vincenheller.[a]
- California—*Berkeley:* E. W. Hilgard.[a]
- Colorado—*Fort Collins;* L. G. Carpenter.[a]
- Connecticut—
  - State Station: *New Haven;* E. H. Jenkins.[a]
  - Storrs Station: *Storrs;* L. A. Clinton.[a]
- Delaware—*Newark:* A. T. Neale.[a]
- Florida—*Lake City:* Andrew Sledd.[a]
- Georgia—*Experiment:* R. J. Redding.[a]
- Hawaii—
  - Federal Station: *Honolulu;* J. G. Smith.[c]
  - Sugar Planters' Station: *Honolulu;* C. F. Eckart.[a]
- Idaho—*Moscow:* H. T. French.[a]
- Illinois—*Urbana:* E. Davenport.[a]
- Indiana—*Lafayette:* A. Goss.[a]
- Iowa—*Ames:* C. F. Curtiss.[a]
- Kansas—*Manhattan:* J. T. Willard.[a]
- Kentucky—*Lexington:* M. A. Scovell.[a]
- Louisiana—
  - State Station: *Baton Rouge.*
  - Sugar Station: *Audubon Park, New Orleans.*
  - North Louisiana Station: *Calhoun;* W. R. Dodson.[a]
- Maine—*Orono:* C. D. Woods.[a]
- Maryland—*College Park:* H. J. Patterson.[a]
- Massachusetts—*Amherst:* H. H. Goodell.[a]
- Michigan—*Agricultural College:* C. D. Smith.[a]
- Minnesota—*St. Anthony Park, St. Paul:* W. M. Liggett.[a]
- Mississippi—*Agricultural College:* W. L. Hutchinson.[a]
- Missouri—
  - College Station: *Columbia;* F. B. Mumford.[d]
  - Fruit Station: *Mountain Grove;* P. Evans.[a]
- Montana—*Bozeman:* F. B. Linfield.[a]
- Nebraska—*Lincoln:* E. A. Burnett.[a]
- Nevada—*Reno:* J. E. Stubbs.[a]
- New Hampshire—*Durham:* W. D. Gibbs.[a]
- New Jersey—*New Brunswick:* E. B. Voorhees.[a]
- New Mexico—*Mesilla Park:* L. Foster.[a]
- New York—
  - State Station: *Geneva;* W. H. Jordan.[a]
  - Cornell Station: *Ithaca;* L. H. Bailey.[a]
- North Carolina—*Raleigh:* B. W. Kilgore.[a]
- North Dakota—*Agricultural College:* J. H. Worst.[a]
- Ohio—*Wooster:* C. E. Thorne.[a]
- Oklahoma—*Stillwater:* J. Fields.[a]
- Oregon—*Corvallis:* J. Withycombe.[a]
- Pennsylvania—*State College:* H. P. Armsby.[a]
- Porto Rico—*Mayaguez:* D. W. May.[c]
- Rhode Island—*Kingston:* H. J. Wheeler.[a]
- South Carolina—*Clemson College:* P. H. Mell.[a]
- South Dakota—*Brookings:* J. W. Wilson.[a]
- Tennessee—*Knoxville:* H. A. Morgan.[a]
- Texas—*College Station:* John A. Craig.[a]
- Utah—*Logan:* J. A. Widtsoe.[a]
- Vermont—*Burlington:* J. L. Hills.[a]
- Virginia—*Blacksburg:* A. M. Soule.[a]
- Washington—*Pullman:* E. A. Bryan.[a]
- West Virginia—*Morgantown:* J. H. Stewart.[a]
- Wisconsin—*Madison:* W. A. Henry.[a]
- Wyoming—*Laramie:* B. C. Buffum.[a]

[a] Director.
[b] Assistant director.
[c] Special agent in charge.
[d] Acting director.

U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 154.

A. C. TRUE, Director.

PROCEEDINGS

OF THE

NINTH ANNUAL MEETING

OF THE

AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS,

HELD AT

ST. LOUIS, MO., OCTOBER 18–20, 1904.

EDITED BY

W. H. BEAL and JOHN HAMILTON,
For the Office of Experiment Stations,

AND

G. C. CREELMAN,
For the Association.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES IN THE UNITED STATES AND CANADA.

	Name of official.	Post-office.
United States:		
Alabama	C. A. Cary, Alabama Polytechnic Institute	Auburn.
	G. W. Carver, Director Agricultural Experiment Station.	Tuskegee.
Alaska	C. C. Georgeson, Agricultural Experiment Station.	Sitka.
Arizona	R. H. Forbes, Director Agricultural Experiment Station.	Tucson.
Arkansas	H. S. Hartzog, President University of Arkansas.	Fayetteville.
California	E. J. Wickson, University of California	Berkeley.
Colorado	A. M. Hawley, Secretary State Board of Agriculture.	Fort Collins.
Connecticut	J. F. Brown, Secretary State Board of Agriculture.	North Stonington.
	J. O. Noble, Secretary Connecticut Dairymen's Association.	Hartford.
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Georgia	H. C. White, President State College of Agriculture.	Athens.
	Harvie Jordan, Director of Farmers' Institutes	Monticello.
Hawaii	J. G. Smith, Agricultural Experiment Station	Honolulu.
Idaho	H. T. French, Director Agricultural Experiment Station.	Moscow.
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Indiana	W. C. Latta, Director Farmers' Institutes	Lafayette.
Iowa	J. C. Simpson, Secretary State Board of Agriculture.	Des Moines.
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Louisiana	J. G. Lee, Commissioner of Agriculture	Baton Rouge.
Maine	A. W. Gilman, Commissioner of Agriculture	Augusta.
Maryland	W. L. Amoss, Director Farmers' Institutes	Benson.
Massachusetts	J. L. Ellsworth, Secretary State Board of Agriculture.	Boston.
Michigan	L. R. Taft, Director Farmers' Institutes	Agricultural College.
Minnesota	O. C. Gregg, Director Farmers' Institutes	Lynd.
Mississippi	J. C. Hardy, President Agricultural and Mechanical College.	Agricultural College.
Missouri	Geo. B. Ellis, Secretary State Board of Agriculture.	Columbia.
Montana	F. B. Linfield, Director Agricultural Experiment Station.	Bozeman.
Nebraska	E. A. Burnett, Director Agricultural Experiment Station.	Lincoln.
Nevada	J. E. Stubbs, President Nevada State University.	Reno.
New Hampshire	N. J. Bachelder, Secretary State Board of Agriculture.	Concord.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 154.

A. C. TRUE, Director.

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Walter H. Evans, Ph. D.—*Chief of Division of Insular Stations.*

John Hamilton—*Farmers' Institute Specialist.*

C. E. Johnston—*Chief Clerk.*

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W. H. Beal—*Agricultural Physics and Engineering.*

Walter H. Evans, Ph. D.—*Botany and Diseases of Plants.*

C. F. Langworthy, Ph. D.—*Foods and Animal Production.*

J. I. Schulte—*Field Crops.*

E. V. Wilcox, Ph. D.—*Entomology and Veterinary Science.*

C. B. Smith—*Horticulture.*

D. J. Crosby—*Agricultural Institutions.*

NUTRITION INVESTIGATIONS.

W. O. Atwater—*Chief.*

IRRIGATION AND DRAINAGE INVESTIGATIONS.

Elwood Mead—*Chief.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., March 15, 1905.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 154 of this Office, a report of the proceedings of the ninth annual meeting of the American Association of Farmers' Institute Workers, held at St. Louis, Mo., October 18–20, 1904.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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RETIRING OFFICERS OF THE ASSOCIATION.

President.

B. W. KILGORE, of Raleigh, N. C.

Vice-President.

E. E. KAUFMAN, of Bismarck, N. Dak.

Secretary-Treasurer.

G. C. CREELMAN, of Guelph, Ontario.

Executive Committee.

The PRESIDENT and the SECRETARY-TREASURER, *ex officio;* GEORGE MCKERROW, of Wisconsin; H. G. EASTERLY, of Illinois; J. C. HARDY, of Mississippi.

OFFICERS CHOSEN AT THE ST. LOUIS MEETING.

President.

J. C. HARDY, of Agricultural College, Miss.

Vice-President.

E. A. BURNETT, of Lincoln, Nebr.

Secretary-Treasurer.

G. C. CREELMAN, of Guelph, Ontario.

Executive Committee.

The PRESIDENT and the SECRETARY-TREASURER, *ex officio;* J. G. LEE, of Louisiana; F. H. HALL, of Illinois; L. A. CLINTON, of Connecticut.

DELEGATES AND VISITORS IN ATTENDANCE AT ST. LOUIS.

Abbott, A. N., Morrison, Ill.
Allen, Ralph, Delaware, Ill.
Amoss, W. L., College Park, Md.
Amoss, Mrs. W. L., College Park, Md.
Anthony, Miss Sallie, Bloomington, Ill.
Barrow, C. J., Baton Rouge, La.
Bassett, L. C., Gibbon, Nebr.
Bates, Mrs. J. W., Broad Ripple, Ind.
Bedford, Miss C. C., New York, N. Y.
Burnett, E. A., Lincoln, Nebr.
Burroughs, E. W., Edwardsville, Ill.
Clinton, L. A., Storrs, Conn.
Cobb, E. N., Monmouth, Ill.
Conner, C. M., Lake City, Fla.
Corbell, J. E., Denver, Colo.
Cottrelle, G. R., Milton, Ont.
Creelman, G. C., Guelph, Ont.
Dean, G. W., Adams, Ill.
Dean, M. L., Agricultural College, Mich.
Dickinson, J. K., Lawrenceville, Ill.
Dodson, W. R., Baton Rouge, La.
Dunlop, Mrs. H. M., Savoy, Ill.
Dye, Franklin, Trenton, N. J.
Dye, Mrs. Franklin, Trenton, N. J.
Easterly, H. G., Carbondale, Ill.
Easterly, Mrs. H. G., Carbondale, Ill.
Elderkin, E. B., Amherst, N. S.
Ellis, G. B., Columbia, Mo.
Ellsworth, J. L., Boston, Mass.
Erf, Oscar, Manhattan, Kans.
Fanton, I. C., Westport, Conn.
Frake, James, Chicago, Ill.
Fuller, F. L., Truro, N. S.
Fuller, Mrs. F. L., Truro, N. S.
Garrett, W. C., Springfield, Ohio.
Garvin, J. B., Charleston, W. Va.
Greeley, M. F., Gary, S. Dak.
Gregg, O. C., Lynd, Minn.
Hall, F. H., Aurora, Ill.
Hamilton, John, Washington, D. C.
Haney, Miss Vesta C., Agricultural College, Mich.
Hardy, J. C., Agricultural College, Miss.
Haward, R. E., Kansas City, Mo.
Hoar, H. C., Bowmanville, Ont.
Hostetter, A. B., Springfield, Ill.
Hughes, W. D., Antioch, Ill.
Hunt, G. A., Hebron, Ill.
Huston, H. A., St. Louis, Mo.
Hutchinson, Wm., Ottawa, Ont.
James, C. C., Toronto, Ont.
Kaufman, E. E., Bismarck, N. Dak.
Kaufman, Mrs. E. E., Bismarck, N. Dak.
Killebrew, J. B., Nashville, Tenn.
Kimzey, W. R., Tamaroa, Ill.
King, D. W., Maitland, Mo.
King, Mrs. S. N., Bloomington, Ill.
Latta, W. C., Lafayette, Ind.
Laws, Mrs. Bertha D., Appleton, Minn.
Lee, J. G., Baton Rouge, La.
Macoun, W. T., Ottawa, Ont.
Maddock, Miss Blanche, Guelph, Ont.
Mason, J. L., Elgin, Ill.
Mason, J. P., Elgin, Ill.
Mason, S. B., Bloomington, Ill.
Maxwell, F. L., Mound, La.
Menges, Frank, York, Pa.
Menn, F. I., Gilman, Ill.
Miles, H. C. C., Milford, Conn.
Moore, S. W., Elwell, W. Va.
MacMurphy, Mrs. Harriet, Omaha, Nebr.
McCartney, J. F., Metropolis, Ill.
McCormick, C. H., McCormick, Ohio.
McCormick, Mrs. C. H., McCormick, Ohio.
McNabb, C. A., Oklahoma City, Okla.
Newberry, H. J., Lone Wolf, Okla.

Newman, J., Elgin, Ill.
Orr, T. E., Beaver, Pa.
Orr, Mrs. T. E., Beaver, Pa.
Putnam, G. A., Toronto, Ont.
Race, T. H., Mitchell, Ont.
Rankin, F. H., Urbana, Ill.
Rossiter, F. C., Chicago, Ill.
Starcher, G. C., Berlin, W. Va.
Stilson, L. D., York, Nebr.
Stubbs, W. C., Baton Rouge, La.
Sweet, M. K., Glenwood, Ill.
Sweet, Mrs. M. K., Glenwood, Ill.
Taft, L. R., Agricultural College, Mich.
Taylor, F. W., St. Louis, Mo.
Thoburn, J. B., Guthrie, Okla.
Trow, A. W., Glenville, Minn.
Utter, Delbert, Lake Beulah, Wis.
Vincenheller, W. G., Fayetteville, Ark.
Whetstone, Dr. Mary S., Minneapolis, Minn.
White, J. M., Douglas, La.
Wyman, B. F., Sycamore, Ill.
Zavitz, C. A., Guelph, Ont.

CONSTITUTION OF THE ASSOCIATION.

Article I.

NAME.

This organization shall be known by the name of The American Association of Farmers' Institute Workers.

Article II.

OFFICERS.

The officers shall consist of a president, vice-president, and secretary-treasurer, to be elected by ballot.

Article III.

MEMBERSHIP.

Any active worker in the farmers' institutes in the United States and Canada may become a regular member of this association on payment of the annual dues, and is entitled to one vote. A delegate member representing the State Farmers' Institute organization shall be admitted from each State and Province, on compliance with the by-laws, and shall be entitled to cast five votes on any question: *Provided*, That the annual membership dues of the person shall be $1 and that of the State $5. Also the United States Department of Agriculture and the Office of Experiment Stations of that Department shall each be entitled to representation in the association, with the full privileges of delegate membership.

Article IV.

DUES.

The annual dues of delegate members shall be $5 for six representatives of each State. The annual dues of members not delegates shall be $1.

Article V.

TERM OF OFFICE.

The term of office of the officers of this association shall be for one year from the 1st day of January next following their election, or until their successors are elected.

Article VI.

DUTIES OF OFFICERS.

The duties of the officers of this association shall be those usually performed by officials of like rank in similar associations.

ARTICLE VII.

ASSOCIATE MEMBERS.

Honorary members of this organization may be elected from time to time upon the presentation of their names by some member of the association and upon their receiving the votes of at least two-thirds of the members present.

ARTICLE VIII.

POWER OF HONORARY MEMBERS.

Honorary members shall be entitled to sit in all of the sessions of the association and to take part in all discussions, but shall have no vote.

ARTICLE IX.

BY-LAWS.

This association shall have power to make by-laws from time to time not inconsistent with this constitution.

ARTICLE X.

EXECUTIVE COMMITTEE.

There shall be an executive committee, consisting of the president and the secretary-treasurer of this association, ex officio, and three other members, to be elected annually by ballot, who shall meet at the call of the president and have charge of such matters of business relating to the association as shall be necessary to attend to in the interval between the annual meetings, and it shall be their duty to report such action as they may take to the next regular meeting of the association.

ARTICLE XI.

CHANGE IN CONSTITUTION.

This constitution shall not be changed except by a vote of two-thirds of the members at a regular annual meeting held one year from the date on which the proposed alteration or amendment has been first presented.

BY-LAWS.

(1) The time of meeting of this organization shall be fixed by the association.
(2) Order of business:

1. Calling the roll of membership.
2. Reading of minutes of previous meeting.
3. Admission of new members.
4. Reports of committees.
5. Election of officers.
6. Appointment of committees.
7. Unfinished business.
8. New business.
9. Adjournment.

PROGRAMME OF THE ST. LOUIS MEETING.

TUESDAY, OCTOBER 18, 1904, 8 P. M.

1. Address of Welcome—F. W. Taylor, Chief of the Department of Agriculture, World's Fair, St. Louis.
2. Reply to Address of Welcome—Maj. J. G. Lee, Louisiana.
3. President's Address—B. W. Kilgore, North Carolina.
    Discussion—Led by George McKerrow, Wisconsin.
4. Roll Call by States and Provinces.

WEDNESDAY, OCTOBER 19, 9.30 A. M.

5. Eight-minute reports from the several States and Provinces. These reports must be written and handed to the secretary, and should contain a synopsis of the work of the past year only, including—
    (a) Number of meetings held.
    (b) Amount of money spent.
    (c) Number of speakers employed.
    (d) General plan of campaign.
    (e) New lines of work inaugurated and carried out.
6. Illustrative Material for Institute Work—John Hamilton, Washington, D. C.
7. Advertising Farmers' Institute Meetings—E. E. Kaufman, North Dakota.
    Discussion—Led by A. L. Martin, Harrisburg, Pa.
8. Address—C. C. James, Deputy Minister of Agriculture for Ontario, Canada.
9. County Organization for Institute Work—W. C. Latta, Indiana.
    Discussion—Led by G. A. Putnam, Ontario.
10. Corn Judging—A. D. Shamel, Department of Agriculture, Washington, D. C.
    Discussion—P. G. Holden, Iowa, and H. F. McMahon, Liberty, Ind.
11. Women's Institutes—Mrs. S. Noble King, Bloomington, Ill.
    Discussion—Miss Blanche Maddock, Ontario; Mrs. J. W. Bates, Indiana.
12. The Relation of the Agricultural College to Farmers' Institute Work—Frank H. Hall, Aurora, Ill.
    Discussion—Led by C. M. Conner, Florida.
13. The Relation of the Experiment Station to Farmers' Institute Work.
    Discussion—L. A. Clinton, Connecticut, and C. A. Zavitz, Guelph, Ontario.
14. How to Train Institute Workers—F. E. Dawley, New York.
    Discussion—Led by G. C. Creelman, Guelph, Ontario.
15. New Problems and Methods in Institute Work—
    (a) East—Franklin Dye, New Jersey; W. L. Amoss, Maryland.
    (b) West—H. T. French, Idaho; J. B. Thoburn, Oklahoma.
    (c) Central—A. B. Hostetter, Illinois; W. W. Miller, Ohio.
    (d) South—J. C. Hardy, Mississippi; W. R. Dodson, Louisiana; C. A. Cary, Alabama.

PROCEEDINGS OF THE NINTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

EVENING SESSION, TUESDAY, OCTOBER 18, 1904.

In the absence of the president, B. W. Kilgore, of North Carolina, the association was called to order at 8 o'clock p. m., in the Agricultural Building, Louisiana Purchase Exposition, by the vice-president, E. E. Kaufman, of North Dakota.

President Kilgore, who was prevented by sickness from being present, sent a letter of regret.

On motion, the letter was accepted, and word was sent to President Kilgore expressing regret at his absence and wishes for his speedy recovery.

A paper on The Use of Illustrative Material for Institute Work was read by John Hamilton, of Washington, D. C. (For paper and discussion, see p. 47.)

For the benefit especially of the new members, the secretary, Mr. Creelman, briefly reviewed the history of the association and some of the provisions of the constitution, particularly that relating to membership.

Mr. F. W. Taylor, chief of the department of agriculture of the Louisiana Purchase Exposition, being introduced, delivered the following address of welcome:

ADDRESS OF WELCOME.

MR. CHAIRMAN, LADIES, AND GENTLEMEN: It is a great pleasure to meet these institute workers. But where did they come from? When I was in charge of the work in one of the States eight or ten years ago I do not think there were more than two or three persons who are present to-night who would have been permitted to pass the doorkeeper at one of our meetings. That shows how rapidly things move, and particularly how rapidly the institute worker has moved and how little I have kept in touch with the work of the institutes. The work of the farmers' institutes has taken a new phase since I first went into it a dozen years or more ago in Nebraska, and it has come to represent an educational value which we did not then seek.

The way in which we handled the farmers' institutes in those earlier days would, I am sure, be rather crude if applied to the present time, but I think that some of us here saw then something of the form which they were to take later on. I felt as I was leaving the work some seven or eight years ago that that particular way in which we had been handling them had about been worked out, particularly in the State I then represented. It seemed to me we had gone about as far as we could along the lines upon which we had originally laid out the work. In that State, up to the time I left the work, there had been practically no appropriation made for carrying it on. It has been a hard work to maintain. A few hundred dollars was all that was available, and the fact that I held a position in the university of the State and incidentally carried the work of the farmers' institute on was the only way in which we were able to carry it forward. Our speakers were not paid. The few hundred dollars we had we used for printing and a few incidental expenses. The railroads of that State may be said to have carried on the work. They supplied transportation without limit upon the request of the superintendent, and aside from that there was practically nothing to go upon except the kind-heartedness and the thoughtfulness and the progressiveness of the men who did the actual work traveling up and down that State and carrying to the farmers, as we tried to carry, something which they perhaps could not otherwise have gotten. And it has been a matter of pleasure to me to see the better form into which the institute work has come. It has come to be better organized. It has come to be more truly and clearly an educational work. And so the work which some of us tried to start in a small way has grown to be something large and important. A few States at that time, even, had their work pretty well organized, but in general I suppose there were not more than four or five States that made appropriations which were sufficient without the support of the railroads or the professors in the agricultural colleges. Without that there were perhaps not more than four or five States in the work which could have existed even as we carried it on in those days. The growth of the work, the establishment of an office for the study of that work in the Department of Agriculture, and a good many things of that nature, which have come up to this time in such good form as they occupy to-day, were only outlines. I remember that in the last one or two meetings that I attended, and of which I was secretary, the thing that we claimed then to ourselves, although I think we expected they would be some years in the future, was that there might be a man in the Department of Agriculture who might study the work and go out and do what he could to make it possible to carry on that line of work in the States which did not then have aid. I presume that there are two or three times as many States carrying on that work now as then, and I know there are three or four times as many States making appropriations to maintain the work as a regular part of the State work as there were then.

After all, when you get back to the beginning of things, whether it be farmers' institute or the work which is done in the colleges or the experiment stations or the work which is done in expositions, it is educational work. I have a feeling that in leaving the institute and taking up the work which I have had to carry in the last three expositions that I have been doing educational work, and I believe that we all have a right to consider that the work which we do in institutes is an educational work of a character which could scarcely be carried on in any other way.

It is a pleasure to me, as chief of the department of agriculture of this exposition, which is held in the center, nearly, of what we believe to be the greatest agricultural portion of the country, to have you meet with us. It was a pleasure to me to extend, representing the exposition, an invitation to hold your meetings here. It causes some regret that I know so few of you and to feel that in the comparatively short time I have been out of the work it has grown and brought in new people until I am almost a stranger, so far as my relation to your particular work is concerned. But that ought to give pleasure only, for it is only by growth and advancement and by bringing in new life that a work of this sort can exist. It seemed to me in the last years I was in it that the time was coming when there must be a change, an advance in the methods. I remember talking in almost a pessimistic strain in the last days I was connected with the work, expressing the opinion that it would have to take a new start or stop. I am glad to say it did not stop, and the work has gone on much better than it went on in the way we used to have to carry it on.

I am delighted to know it is progressing so well, and I am glad that at this initial session of this meeting there are so many present. I am glad that the scope of the organization was so extended—as it was during the last year or so that I was a member of it—as to take in a good many who before that time would not be eligible. I remember changing in the earlier days to the belief that the right plan was to take in the workers—all those who had to do with the direct work of the institute. I am glad that the change was made, and the change is evident by the considerably larger number present than we had at any of the meetings during the time that I was connected with the work. I hope that I may have the pleasure of showing some of you, either as a body or individually, what has been done in the bringing together of the agricultural products of the States and provinces which are represented here.

I hope that as you go through the building you will realize something of the enormous work which each State and Province has done in bringing this exhibit together. My own work and my office has been simply executive. I feel sometimes that we are entitled to very little credit for what has been done here, but to whomsoever the credit may belong I think you will find a magnificent exhibit in this building and the building to the south. I know you will say that there is a splendid showing of the agricultural products, not only of this country, but of foreign lands, and as representing those exhibits, in an executive capacity, and in the name of the exposition, I welcome you here and hope you may find your stay not only pleasant but extremely profitable. I am delighted, as I have said, to greet you and welcome you, and to offer you every facility which we have at our disposal.

Mr. J. G. Lee, of Louisiana, delivered the following:

Reply to Address of Welcome.

Mr. President and Gentlemen of the American Association of Farmers' Institute Workers: Besides appreciating the great honor it affords me an inexpressible amount of gratification to have been chosen to respond, on behalf of this important organization, to the warm welcome extended us, and clothed in such eloquent language, by Mr. F. W. Taylor, as chief of the department of agriculture of this, the greatest of all world expositions. No language of mine could adequately convey to you, sir, the feeiing of appreciation and thanks which this association desires to express on this occasion.

The work which may be said to be here represented by this gathering is one of momentous import to the American farm and to the American home.

Agriculture is the backbone, the mainstay, of our nation; but if we are to maintain the position we are now so proudly occupying, as leaders in the world's production of the fruits of the soil, we must not fail to busy ourselves to keep ahead of increasing competition in the other parts of the world.

Education is the great force to-day that is moving the world's immense industries, and it is to this force we must look to stimulate and to build up, to its highest state of perfection, that greatest of all industries—agriculture—with which we are so intimately associated.

The farmers' institute movement throughout America is one which has required patient work and fostering care to bring to where it is to-day. Many have been the obstacles placed in the way of its progress from its inception, inspired by ignorance, no doubt, of its true value to the large class of our citizens for whom it was specifically instituted. Thanks, however, to the stout hearts, and the indefatigable efforts of those who have been and are laboring in this important field, the barriers are being gradually but permanently lowered, and to-day that hope which "springs eternal in the human breast" is being realized in a measure greater, perhaps, than our most sanguine expectations in the improvement of general agricultural conditions throughout the country.

Some sections have, of course, benefited to a larger extent than others, because of the movement having been earlier instituted, or, as is the case in some parts of our southern country, the soils are so fertile and the climatic conditions so conducive to luxuriant growth as to render obscure, to some extent, the necessity for increased effort on the part of our people. Increased competition in the world's markets, however, combined with narrower margins in profits in all classes of agricultural products, is deepening to the conviction that to keep abreast we must become more and more educated along all lines pertaining to maximum production. This, I may say, is the gist of our efforts in the institute movement all over the country, and in our southern section it may be said that success is attending our labors, but we are in need of more help. The appreciation of the benefits of the institute is as yet more apparent in Canada and in sections of this country above the "Mason and Dixon" line, resulting in large appropriations made (by those sections) for the successful carrying on of the work. The most effective help that this organization could afford us is their presence with us in our midst, in order not only to encourage us and our people, but to impress our authorities with the great necessity for an increased amount of money to make greater progress possible, an expenditure which I consider one of, if not, the most valuable investments any agricultural State could make. I, therefore, have the honor of bringing a message from his excellency Governor Blanchard, of Louisiana, to hold your next annual meeting in Louisiana, the richest agricultural State in the South and of the Union, and in our beautiful capital city of Baton Rouge, situated upon the bluffs of yon great Father of Waters.

Come to our capital city for your next meeting, and come as our friends and neighbors and with the spirit of sympathy and helpfulness and as coworkers in a great educational movement for the American home and the American farm. Come and receive a royal southern welcome—a warm-hearted, hospitable, Louisiana welcome.

I thank you, gentlemen, for your very kind attention.

At 10 o'clock the convention adjourned until Wednesday morning, October 19.

Morning Session, Wednesday, October 19, 1904.

The convention met at 10.15 o'clock a. m., Mr. Kaufman in the chair.

Preparation of Programme of the Meeting—Eight-minute Reports.

The Secretary. I would like to say, first, that we probably have had more trouble in regard to the eight-minute reports, so far as our programme is concerned, than in any other particular during the last five years of our history. Delegates from the different States, especially men representing their States for the first time, are very apt to make the mistake of thinking that when called upon for an eight-minute report they must start away back as far as the institute system of the State goes and bring it up to the present date, believing that their experience has beeen unique, whereas as a matter of fact the experience has been much the same in every State and Province. We have not time in a general meeting of this kind, where we have so much to do, to hear the life work of every State farmers' institute. The result is we have had to impress upon each speaker the absolute necessity of devoting his time entirely to the work of the past year. We even found that that did not entirely accomplish the desired result, so we had to outline what he should say, as you will see in the programme of the meeting.

Mr. HAMILTON. May I say, in this connection, that the Department of Agriculture has prepared a set of reports from the several States, giving a history of the organization of the institutes in those States and the condition of work in the different States, so that persons who are interested in knowing the exact condition of things in the several States can have their curiosity satisfied by looking at these reports.

On call of the president, the following eight-minute reports from the various States, Territories, and Provinces were submitted:

EIGHT-MINUTE REPORTS FROM STATES, TERRITORIES, AND PROVINCES.

ALABAMA.

By C. A. CARY, *Auburn.*

From July 1, 1903, to July 1, 1904, 24 farmers' institutes were held in 23 counties of Alabama. The total attendance was 3,639, and the average for each institute was 151.

A ten-day round-up institute was held at the college in Auburn, August 10–14, with an attendance of 130 farmers from a large number of counties of the State.

About $800 was used in paying the expenses of the 24 institutes and the one round-up institute.

A majority of the institutes were held in August—the time most available for the farmers to attend the meetings.

Eleven speakers were employed, and all but two of them were taken from the station force of workers.

We have adopted no especially new features, but our attendance has increased as well as the interest manifested and the greater number of calls for institutes.

ARKANSAS.

By W. G. VINCENHELLER, *Fayetteville.*

Number of meetings held, 5. Amount of money spent, about $50. Two speakers employed. These meetings have been held in response to urgent requests and have usually resulted in the organization of fruit and vegetable growers' associations. The demand for speakers or lecturers for these meetings has been greater than we have been able to fill. The information most generally sought is along the lines of improved agriculture and horticulture. The agriculturist and horticulturist are required to do both station and college work, which prevents us to a large extent from filling the demands made upon us. We hope to have assistants in these departments another year, when we will be able to give more attention to this work. I now have 25 appointments in connection with the horticultural department of the Iron Mountain Railroad. Either myself or a member of the staff will be in attendance upon all these meetings.

CONNECTICUT.

By L. A. Clinton, *Storrs.*

I have done my best to get statistics for farmers' institutes held in Connecticut during the past year, with the following results: Number of meetings held, 20; number of sessions, 40; amount of money expended, $1,000; number of speakers employed, 25. The general plan of campaign was to hold the institutes in connection with the granges of the State. When a grange makes application for an institute, the officers of either the State Pomological Society, the State Dairymen's Association, or the State board of agriculture will arrange for an institute at that place. Sometimes a joint institute is held by some of these associations. So far as I can discover there is no definite plan of campaign. An effort is being made to put the farmers' institutes in this State on a little better basis, but whether we shall succeed or not remains to be seen.

DELAWARE.

By Wesley Webb, *Dover.*

The work of the year in Delaware has been along lines similar to those followed in the past. Number of institutes, 18; number of sessions, 40; total attendance, 4,856; amount of money spent, $600; number of speakers employed, 8. Eleven of the 18 meetings were all-day institutes, held on consecutive days (omitting Sunday), with essentially the same programme. This programme included practical farm topics, agricultural education with special reference to the Delaware Agricultural College, and measures necessary to preserve the native ornamental evergreens of the State. The institute movement is growing in favor with the people and is productive of much good.

FLORIDA.

By C. M. Conner, *Lake City.*

Our plan of campaign was about the same as in previous years, except that in advertising the institutes we got into direct communication with the farmers and addressed them personal letters, and in that way appealed directly to them and thus increased the attendance.

Under new lines of work inaugurated I do not know that we have anything to offer that would be of interest. As most of you know, the Institute work in Florida is new, and we have to educate the people up to what the farmers' institute is. When that is done we will be able to branch out in new lines. We expect to push the work further this year and to ask the legislature for more money for further extension.

During the fiscal year ended July 1, 1904, institutes were held in 19 counties of the State. Eighteen of these meetings were one-day meetings, one a two-day meeting. The amount of money spent, not including printing report, was $853; printing report, $240; number of speakers employed, 8; total attendance, by actual count, 1,605.

IDAHO.

By H. T. French, *Moscow.*

The farmers' institute west of the Rocky Mountains is a very important factor in spreading information among farmers, stock men, and orchardists.

If possible, it is of greater importance than in the East, where better means of communication and contact with one another are found than in the West.

Nature has set up many barriers which have not yet been overcome with means of communication and transportation. Families and communities are widely separated from each other by impassable canyons, mountain chains, and desert lands; but these people are none the less interested in improved methods in agriculture. Indeed, they are often doubly interested, on account of the difficulties which they must overcome ere success will crown their efforts. Long stage trips over sagebrush plains and across mountain passes is often the lot of the institute worker; but when the people are reached in these out-of-the-way places the work is received with earnestness and a determination to get out of it all that is possible. Were it not for the conviction that comes home to one from some encouraging sign that the work was highly appreciated and really benefited some industrious, worthy individual, there would be little to compensate for the effort necessary to reach many of these people. Not all the work is so arduous as this by any means. We have large and enthusiastic meetings in the larger towns and more thickly populated districts near the railway lines. Our best institutes, however, are in the smaller rural settlements. Fifty to 100 deeply interested farmers make a better institute, in my judgment, than 500 present in a town where the element of entertainment usurps the time and leaves not enough solid meat for slower digestion and assimilation. On this account we do not hesitate to go to remote country settlements where a schoolhouse can be secured for the meetings.

What a grand mission to be able to "break the bread of life," as it were, to these struggling, earnest people who by force of circumstances often are compelled in this far western country to deprive themselves of associations which only come with denser population and greater production of the commodities which the railroad seeks to transport. Thus we would place lack of transportation facilities and long distances to travel among the most trying conditions to overcome in institute work in the West.

It is not easy to supply instructors to keep pace with the growing demands for this work.

The experiment station staff is taxed to the limit and should be relieved from too much institute work.

I believe the institute furnishes one of the best means of bringing the station worker in contact with the people whom he wishes to benefit, and he should not on this account be entirely relieved from institute work.

This is doubly true in the West, where the conditions vary so greatly in comparatively short distances. Altitude, proximity to mountain and timbered lands, exposure to the winds which sweep the plains, all have a marked influence on agricultural possibilities, and it is quite necessary that the investigator become as familiar with these local conditions as possible in order to apply the results which he secures in the laboratory or field located oftentimes hundreds of miles away. The institute offers opportunity for an interchange of ideas with the farmers on the ground where the application of scientific data must be made better than any other means available at the present time.

This personal contact is far better than the printed report on results obtained at the station. So I think that while it is not an easy task to determine just how much institute work should be done by station men, it is easy to see that a portion of their time can be profitably spent in this way.

We need in the West more men who have been trained in gathering data and have the faculty of communicating it to men engaged in practical affairs. We have not such a large number of graduates of agricultural colleges to draw from as you have in the East. Our institutions are young and robust, but have not as yet a large list of graduates.

A regular system of institutes is now in force in Oregon, Washington, and Idaho. The latter States receive support for institute work by regular appropriations from the State legislatures. Oregon as yet does not receive such support, I believe. In our own State the work is growing rapidly and demands a still more liberal support, so that more instructors may be employed. Transportation companies are doing much to assist in overcoming the large expense necessary to reach remote parts of the State. It costs nearly as much to go from the northern end of our State to the southern as it does to go to Chicago and requires nearly as much time. It is not an uncommon occurrence to travel by rail 800 miles to attend a farmers' institute in our State.

These are a few of the thoughts which occur to me which may be of interest to others who no doubt have equally difficult problems to solve in carrying forward this grand system of education which means so much in the development of the great resources of the country as well as in the increase of human happiness and comfort.

ILLINOIS.

By A. B. Hostetter, *Springfield.*

One hundred and five institutes were held; 63 of these were of two days' and 42 of three days' duration. Total number of sessions, 609; total attendance, 84,681; total sum spent directly for institutes, $10,673.79. This does not include office expenses, salaries, nor expenses of directors. Seventy-five dollars is appropriated to each county by the State, and twelve county boards made additional appropriations varying from $50 to $200 each.

No salaried speakers were employed. Nineteen members of the faculty of the college of agriculture attended a total of 159 sessions, 80 per cent of the counties securing help from the college.

The other speakers, with a few exceptions secured from other States, were taken from the ranks of active farmers, housekeepers, and teachers.

Sixty county superintendents of schools cooperated with the county organization in promoting the institute and interesting the farm boys in corn growing.

Seventy-six per cent of the institutes had exhibits, and seventy institutes had domestic science represented on their programmes, and the majority of these gave one entire session to the subject. The subjects which were made a special feature for the year were maintaining soil fertility and teaching agriculture in the public school.

A new, live, and special feature was the exhibition of and award of prizes on corn grown by boys under 18 years of age from pure seed sent out by the institute. This corn-growing contest greatly increased the attendance of young people at the institute, and was regarded so favorably that corn was sent again to 5,521 boys in the spring of 1904, to be grown and exhibited at the institutes of 1904–5.

Two hundred traveling libraries were kept in circulation during the year, visiting over 300 communities.

The class work at the annual round-up institute, February 23–25, 1904, although not a new feature, was extended to include classes in live stock, with specimens of horses, cattle, and hogs, for comparison and demonstration; class in poultry; class in dairying, with demonstrations of testing, separating milk, and making butter, all carried on on the rostrum of a church; classes in domestic science, in corn judging, and in horticulture.

We have found that there is great educational value in the doing of things before an institute audience.

Twenty thousand copies of an annual report of 366 pages were printed and distributed. During the months of April and May, 1904, conferences of the institute directors and a representative from each county institute in the Congressional district were held; the superintendent of institutes attended these conferences and circuits of institutes, and dates and places for the ensuing year were agreed upon. One hundred and nine scholarships in the college of agriculture were awarded through the institute.

In reply to questions by Mr. Creelman, Mr. Hostetter stated that about 10,000 copies of the annual report of the Illinois farmers' institutes were distributed to the institute organization through its officers, and 10,000 copies were turned over to the secretary of state for distribution to libraries, members of the legislature, and others. The report is printed by the State as a part of the regular State printing.

INDIANA.

By W. C. Latta, *Lafayette.*

Number of institutes held, 175; two-day meetings, 165; one-day meetings, 10; total, 340 days and 832 sessions.

Every county had one institute and many had two or more.

The average attendance, 338; aggregate, 59,189.

Assigned speakers, 48, 9 being from the university and experiment station staff.

Ten or twelve separate sessions for women were held. Women had charge of a few general sessions of the farmers' institutes.

Two speakers, as a rule, are assigned to each institute. The average cost to the State for speakers was about $33.

The direct allowance to each county for local expenses was, as heretofore, $25. The aggregate cost to the State for speakers and local expenses was about $47. The expenses of the superintendent's office, including salaries, printing and stationery, postage, etc., were about $2,000.

During the past year, over half of the counties adopted the permanent form of local organization for institute work recommended by the general management.

Woman's auxiliaries exist in eight or ten counties. Steps have already been taken to have a general organization of the farm women of the State.

The special features of the work during the past year were corn judging at many of the meetings, live-stock judging at a few institutes, and the presentation of the subject of good roads at about 25 of the meetings.

Attention is now being called to the importance of interesting the young people of the farm and introducing the subject of nature study and agriculture in the public schools. Steps already taken insure that these important matters will receive attention at most of the institutes the coming season.

Mr. Latta, replying to questions, stated that definite agricultural instruction is not given in the public schools of Indiana except in a few instances. During the past year for the first time a few teachers began the use of some of the elementary treatises on agriculture. He has urged the development of nature study.

LOUISIANA.

By J. G. Lee, *Baton Rouge.*

I want to preface my report by saying that there is each year a continued and greater interest manifested in my State in the farmers' institute work—a work enly limited in its possibilities for doing great good to the adult farmers by the funds at our command. It is those mostly whom we desire to reach and teach, and from all parts of the State comes a constant demand for institute organizations. We held, during the year coming to a close, 50 institutes in 37 of the 59 parishes, with an average attendance of 280, and a total of more than 14,000.

In addition to these institutes, there are some forty-odd fruit and truck growers' associations, now well organized, conducting their affairs with material success and development of this industry, for which parts of the State, both alluvial and hill lands, are well adapted. In all cases where intensified farming is followed with close attention to the requirements of particular fruits and vegetables, with liberal use of suitable fertilizers for products and soil, the net results per acre have been largely remunerative, surpassing the yield and net results of any yield of staple crops, such as cane, cotton, and rice. In many instances, and one in particular, at Roseland, Tangipahoa Parish, where business methods and careful attention are paid to all the details of truck farming, supplemented with the free use of fertilizers best adapted to the soil and irrigation from pumping wells is followed, the profits have been enormous. At Roseland, a small farm of 25 acres, with 10 acres in pasture and 15 in cultivation, the vegetable crops have netted a yield of $5,600 after all farm expenses, including cost of marketing, had been paid. Many farmers are embarking in this industry, and, with railroad facilities and lands adapted to the growth of garden products, are reaping a good annual income. The department keeps in touch with all these organizations, encouraging and lending every assistance possible by sending practical and successful truck growers to lecture and give instruction along these lines, which have awakened many farmers to the importance of this industry, and done much to improve methods and give a clear conception of the great importance of diversified farming.

At the places of meeting permanent local farmers' institute clubs are organized, with a local president, secretary, and vice-president for each ward in the parish in which these institutes are held. The local organizations serve as local headquarters for the annual visit of the corps of institute workers, and assist materially in the distribution of agricultural literature, programmes, and posters, and doing missionary work in advance of the meetings, and acting as representatives, locally, of the Louisiana State board of agriculture and immigration. These local organizations are composed of progressive farmers seeking agricultural knowledge and desiring in every way to improve their conditions along these lines, and they form the official link connecting the local organizations with the State department of agriculture at the capitol building. It is also the purpose of the commissioner to hold, at as early a date as practicable, a general "round-up" of all the institute workers and members of clubs at the Louisiana State University and Agricultural and Mechanical College, at Baton Rouge, La., for the purpose of consulting, exchanging views and opinions, and receiving suggestions looking to the continued expanding, improvement, and betterment of this important work undertaken and being done by our department. The work is not over, as the closing results indicate that our institutes have a larger attendance than those held in any previous year. The work is not only well in hand with the smaller farmers, but is rapidly extending to the large sugar, cotton, and rice planters, with promise of good results for the future. Another new feature that I desire to mention is the discussion of the good-roads movement by the department and the cooperation of the United States good-roads expert, to seriously engage the attenion and thought of our people, and from now on this will be the slogan of the department until the good work is accomplished and some systematic laws passed by which we can see the fruit of our labor carried on more economically and successfully. Through the work of the farmers' institutes, the State board of education has secured the teaching of elementary agriculture in the public schools of the State. It is now also the cooperative work of the two departments of education and agriculture to establish school gardens in connection with the rural public schools, thereby giving practical instruction to the young mind whose calling in after life is to be that of an agriculturist.

Those composing the institute corps for the year closing were as follows: Fourteen experiment station and agricultural college men, who are regular lecturers; 4 from other States; 2 from the U. S. Department of Agriculture, and 10 from the practical and successful farmers of the State. Thus it will be seen that our institute corps is made up largely of specialists from our agricultural college, experiment stations, lecturers from other States, and our own practical and most successful farmers, and it will be my constant aim and policy to elaborate and make this important work more and more effective. I should here mention that $2,000 is annually set aside from the appropriation made by our legislative body for this institute work, but it is inadequate to carry out the full scope of the work that I have mapped out to its legitimate effectiveness, and hence this department is handicapped in developing and broadening the field of its work as rapidly as is desirable to cover thoroughly and effectively all the 59 parishes of the State. But to those who have learned "to labor and to wait" these results are bound to come, for everywhere there is an awakening interest among the farmers, and their representatives see and know the necessity for a more liberal appropriation, which will doubtless be made in the future.

As regards the department's work along the lines of encouraging immigration to our inviting and fertile fields, I would state that a vast amount of literature—Louisiana's Invitation, hand maps, showing alluvial and hill lands, nature of soil, etc.—is distributed to all parts of the United States and foreign countries direct from the department and through the efforts of the railroads, the Illinois Central, Missouri Pacific, Southern Pacific, and Red River Valley being most active in cooperating and are using every legitimate means to attract worthy immigrants and settlers to the splendid advantages offered in Louisiana to come and settle here while lands are comparatively cheap.

Louisiana was quick to recognize the importance of this great work and was the first southern State to inaugurate a permanent farmers' institute system, and ours was the first southern State legislature to recognize their value and to appropriate funds for their conduct, which appropriation has been made annually since the work was first started.

Thus, Mr. President, you will see that we are abreast of the times and keeping pace with the new ideas, thoughts, and progressiveness of other States.

MASSACHUSETTS.

By J. L. Ellsworth, *Boston.*

I regret that I have not a written report, but I shall try to give you a brief statement of the work in Massachusetts.

The number of institutes held was about 100. The cost of the institutes was somewhere about $1,000, making the average, I believe, a little over $10 at each institute. Now, I can tell you the reason why this is so low. Massachusetts is one of the small States of the Union, as you are aware, and its agricultural interests are of minor consequence, it being a great manufacturing State. Travel from place to place is necessarily very light, and we use many of the professors of the agricultural college. The price paid for each speaker is $10 and his expenses, and when the secretary of the board is called out he goes free, as both his salary and the expense are paid by the State.

The number of speakers employed I will not attempt to give you. The board of agriculture that has charge of this work gets out each year a list that includes the professors in the agricultural college and many prominent speakers in New England States, and when we get one from outside the State we usually attempt to keep him for a week, which makes his traveling expenses very light.

The new lines of work that are being taken up in Massachusetts are demonstration work. A general institute was held at the agricultural college last summer, and all the different lines or different organizations of the State were invited to cooperate in it. The fruit growers' association, the cattle owners' association, the creamery interest, and the grangers were all invited. We had a very fine institute. There were demonstrations in creamery work, which is of special interest in the western part of the State. A part of one day was used in the mixing of insecticides and fungicides and the exhibition of spray pumps. The fruit men were very much interested, and the fighting of the insects and of fungus growth on the fruit and vegetables is of great importance among the market gardeners of Massachusetts. We had a very large attendance, and it was probably one of our best meetings ever held in Massachusetts.

The average attendance of our institutes is 104. The largest attendance was something between 300 and 400, and perhaps the smallest was about 25. Sometimes we have small attendance owing to conditions beyond our control—that is, the weather. If we have an institute advertised on a day when the weather is stormy and the roads bad, the attendance is naturally small. I presume this is the same way in other States.

I wish to say that the institute work in Massachusetts is growing, as I presume it is in all other States; that the farmers are beginning to realize that the speakers that we employ are from the experiment stations and have had practical experience. Occasionally we get a very successful man who has farmed and made lots of money, and people interested in the same line of agriculture which he has pursued want to know how he has done it, and we perhaps get hold of such a practical man. So they are finding out that the institute is one of the great teachers. Another plan is also getting the grange to help. In some instances where the Pomona Grange took hold with the regular farmers of a county or town the attendance has been very largely increased..

MICHIGAN.

By L. R. Taft, *Lansing.*

I can report verbally that during the past year we held in Michigan 300 institutes, of which 75 were two-day county institutes, covering practically all the counties in the State, except some of the mining and lumber counties in the north, with 224 one-day institutes scattered through the counties and a three-day institute at the agricultural college as a sort of round-up.

The appropriations for institutes last year was $8,000, of which about $5,000 was spent for the one and two day institutes paying the per diem expenses of the speakers, and the remainder for the round-up institute and salaries, the printing and mailing of the reports. We secured, and have for years secured, mailing lists from the various counties through the membership list of the different county institute societies, and when printed the reports were mailed direct to each member. Others were sent, of course, to libraries, newspapers, prominent farmers, etc. The speakers regularly on the list numbered about 60, but we had in addition some 15 at the round-up institute, several of whom came from outside the State. In this list of speakers we had 15 ladies, and at practically all of the two-day institutes we had a lady upon the programme for about four talks, many of them discussing matters relating to butter making, poultry raising, and other outdoor matters, as well as education and the household. In some cases, perhaps 50 per cent of the meetings, we had domestic science upon the programme. These talks, however, were given in connection with the women's section, and these with us are no new venture. They have been held for some eight years and they have been a very valuable part of our institute work.

The round-up institute and the college had a joint meeting with the State dairymen, the horticultural society, the bee keepers' association, and we received the heartiest assistance of various other organizations, including the State grange, the State farmers' clubs, and the different stock breeders' associations, giving up one or more sessions to each, and besides that most of them held separate sessions. We gave up the evenings to matters relating to legislation and education, with various other topics in the afternoon along those lines. During the first two hours of the forenoon we had sectional lectures in various departments of the colleges. On some morning when the dairymen were there we had the dairy work explained by the instructor in charge. The same was true in horticulture and stock feeding, or, perhaps I should say, stock judging and corn judging, and in the women's department. The libraries were all open and in certain hours of the day the work of the college was explained and the laboratory work of the students was investigated.

I will say that we issue 9,000 copies of the institute reports, and for the first time have mailed them direct to the members. Before that they were sent to the county secretaries to be given out at the meetings. But we are able to put them in the hands of the farmers several months earlier and have been well repaid by the benefit secured. Printing and postage are paid for by the State.

MINNESOTA.

By O. C. Gregg, *Lynd.*

We have held during the past year 154 institutes, made up of 129 one-day institutes and 25 two-day institutes, the total number of sessions being 378.

Our total attendance, figured according to the association method, has been 46,210.

The two-day institutes were held in the larger towns of the State, and had an average attendance of 510.

The single-day institutes were held in the smaller towns, with an average attendance of 259.

Our appropriation for the year was $18,000. This paid all the expenses of the institutes, including salaries and the publishing of our institute annual.

We have employed 13 speakers in all.

We have commenced the organization of a women's department of our institute work, 19 local institutes being organized during the year. These different institutes hold monthly meetings, and reports show that the membership and interest have increased steadily. Each month we have selected a bulletin from the list furnished by the U. S. Department of Agriculture, and a copy of it has been forwarded from Washington to each individual member. These bulletins have been studied at home and then discussed at the meeting. Plans for the distribution of other literature are now being considered.

A circuit of 11 institutes was held, in which particular attention was paid to the potato industry. These meetings were held in the potato district north of St. Paul and Minneapolis.

MISSISSIPPI.

By J. C. Hardy, *Agricultural College.*

The number of meetings held in Mississippi during the past year was probably more than have been held during the entire history of the farmers' institute—165. Money spent, $3,000. The first appropriation ever made was in 1900, $500; in 1902, $1,500; and this last January, $3,000 a year. Number of speakers employed, 18.

We have had no permanently organized institutes in our State until about two years ago. This year we have undertaken to perfect the organization, and we have done so, with the exception of the Delta, where we have never undertaken to hold institutes, the Delta people believing purely in the negro and the mule, and thinking that scientific agriculture can do them no good at the present stage. We have located an experiment station in the Delta, however, and expect, with the menace of the boll weevil threatening our people, that we can do some work there and demonstrate that there is more possibility in the Delta than mere King Cotton in the raw state. We have mapped the State out into districts—the horticultural district, the dairy district, and the general agricultural district, and so on—and sent speakers especially adapted for the different sections. About three weeks is the time occupied by each tour. In addition we have what is called the country district and the river district. Through the country district the institute staff generally go about six weeks, with two teams.

What we have tried to push this year is bee keeping and poultry work, which we expect to make prominent in the experiment station. Terracing has also received much attention. Our people since the war have been given almost entirely to cotton raising. As a result, our lands have been badly washed. We have therefore been emphasizing the importance of reclaiming these lands by means of controlling the water, by terracing, and otherwise. As a demonstration we actually terraced a man's field for him in some of our institute work. We consider this a very practical method.

We have just organized in our college industrial pedagogy, probably the first course of the kind that has been organized, for the purpose of educating our teachers in agriculture and manual training in our schools. We realize that we must have trained teachers for this work. We also expect to hold a rural school at the college for four weeks next year.

MISSOURI.

By G. B. Ellis, *Columbia.*

The farmers' institute work in Missouri is under the control of the State board of agriculture, and the secretary of the board is the institute director. We try not to be governed in our work in Missouri by any hard and fast rules, but are trying to develop a system of farmers' institute work suited to our needs by adopting the best methods we can borrow or that we can work out ourselves, modified, of course, to suit our own local conditions.

During the year ending June 30, 1904, we held 147 meetings, of which 141 were one-day, 5 were two-day, and 1 three-day meeting. The total attendance was 30,220. The institute season began October 12 and ended April 2. The appropriation for the year was $5,000, out of which a little more than $1,000 was used for printing and part pay of the director's salary, but to balance this expense the clerical help is paid for out of other funds. We get no money from any other source whatever.

Twenty-eight men were on the institute staff, 13 from the agricultural college and experiment station and 15 others. Three lecturers were employed from other States. No woman's work has been introduced, owing to the disapproval of the board. I hope, however, to overcome the opposition soon and take up woman's work.

Our aim is to give the farmers something they can use, and to accomplish this we use as much illustrative and demonstrative material as possible. A passenger car, fitted up in what might be called an institute laboratory, has been used in a number of meetings, and has given excellent results. (See Thirty-fifth Annual Report of the Missouri State Board of Agriculture, p. 15.) Our soil, climate, and crops are so diversified that we must consider a very wide range of subjects, which makes it very difficult for us to secure the necessary help in our institute work, but I am glad to say that we can report material progress during the year and an increased interest in our work among the farmers of the State.

NEBRASKA.

By E. A. Burnett, *Lincoln.*

The institutes in Nebraska have become prominent factors in the agricultural development of the State.

The institute season began November 23, 1903, and closed March 24, 1904. Forty-three one-day institutes and 49 two-day institutes, total 92, with a total of 330 sessions, were held. The total attendance was 26,000 people, figured according to Government methods. Institutes were held in 57 counties. The State appropriation for institute work is $6,000 per year. Institutes are operated under the regents of the university, and not under a special enacted law.

Ten men connected with the university and station did institute work, spending 52 days in the work. Fourteen other lecturers were employed by the State, these giving their entire time to the institutes while in the work. We combine local and central organizations, holding no institute except on request, and always ask the community to bear a part of the expense, generally amounting to the hall rent, local advertising, and local entertainment of speakers at hotels. Dates are made at least six weeks in advance and institutes arranged in series.

The subjects of soil tillage, varieties of wheat, oats, and corn, and of forage crops are all prominent. Alfalfa growing is a leading subject in many localities, and the efforts of the institute force is constantly exerted to extend the area of alfalfa. The breeding and selection of seed corn is a prominent factor in our institutes and many exhibits of seed are made for purposes of competition. These exhibits are judged by a competent man on the institute force. In a few places contests among the boys in growing corn are being carried on.

The treatment of animal disease is one of paramount importance in Nebraska and ably treated at our institutes.

Being a great live-stock State, the questions of feeding cattle, sheep, and hogs are much discussed. During the regular season we employ two speakers to talk on economic pork production and one man to talk cattle feeding whenever such a man is available.

Questions of crop rotations and soil fertility are coming to be much discussed, especially in the older sections of the State, where land is now high in price and rentals correspondingly high.

Poultry products form a leading factor in our industry and receive attention from the institute platform.

Recently we are giving attention also to the rearing of horses.

Last year for the first time the subject of road building received attention in an effort to improve the earth roads of the country.

The subjects assigned to any particular institute depend on the local demands. An effort is made to send speakers familiar with the needs of the several localities and to conform so far as possible in matter of subjects to the requests of the local committee.

Lady speakers are used, though not extensively, confining their subjects to household-science topics, poultry, etc. In a few institutes separate women's sessions were held and these were usually successful.

NEW JERSEY.

By Franklin Dye, *Trenton.*

The number of farmers' institutes held in New Jersey during the fall and winter of 1903–4 was 27. This does not include the annual meeting of the State board of agriculture, covering three days and seven sessions, nor the meeting of the State Horticultural Society—two days.

The amount of money expended in the institute work was $1,616.55. There were 86 sessions held. There were 8 speakers (3 of whom were from another State), not including the conductor nor a half-dozen others who made but one, two, or three addresses.

The subjects treated included fruit production, large and small; marketing farm produce; asparagus production; potato, tomato, pepper, and melon growing; dairy matters in general; poultry and egg production; soils—composition, variety, requirements, etc.; plant food in general; entomology; grass production; intensive and extensive farming; home life and home adornment; sanitation and hygiene, etc.

New subjects are considered from time to time as their importance seems to demand and as our farmers take them up in practice. For example, last season we presented, at suitable places, "squab raising." It is a growing industry in New Jersey. The question of soils, already referred to, is a new subject, although the soils are old. They have not hitherto been scientifically studied and presented to the farmers in such a way that they could understand and adopt the teachers' conclusions.

This subject was considered in a general way at a number of institutes last winter. During the coming institute season the question will be presented more in detail and will cover nine subdivisions, or heads. Similarly the subject of asparagus production. This is a very important crop in New Jersey, and last year at a number of places, where the soil is adapted to its production, the best methods of culture were given by a leading producer of this crop.

The interest manifested in the subjects presented, as indicated by the questions asked, was deeper and more intelligent than heretofore. The effect produced by the institute in the localities where held is more extended and the influence more abiding. This improvement is shown by the adoption of the suggestions presented at the institute, and where these new theories and methods produce better results than the old did the institute as a help to the farming profession has passed beyond the experimental period.

Our plan of work is simple. The first notice sent out contains a list of all the meetings to be held, the place, and the date. This notice goes to the newspapers and the various farmers' organizations. The next notice is the programme of the meetings, containing place of meeting, hall, list of subjects and speakers, a few paragraphs on the purpose of the institute, and a short statement of who the speakers are. These programmes are sent to the press in the neighborhood where each institute is to be held, also to the local committee, if such there be, to distribute among the farmers by mail or otherwise. In some cases they are mailed from the State board office direct to the farmers.

The third advertisement of a meeting is by large posters. These are sent to the local committee about eight or ten days before the date of the meeting, to be put up in various public places. We are of the opinion that plenty of judicious advertising secures a larger attendance than is likely to prevail where but little notice of the meeting has been given.

The farmers' institute work in New Jersey is steadily improving.

In reply to questions that have been asked, I would say that the State prints our reports. The institute is under the management of the State department of agriculture. We pay our own postage and expressage. We obtain a list of farmers from the granges and from other sources, and usually have some prominent farmer in the grange or other locality to whom we can express a lot of reports and have them distributed by him. A number of years ago, just before I came into the position of secretary, the reports were sent out by mail, and it made an inroad on the funds of over $700, which we could not stand.

The subject of good roads we do not take up. We take up, however, the subject of better roads.

NEW YORK.

By F. E. Dawley, *Fayetteville.*

The winter of 1903–4 marked one of the most successful seasons that New York has ever experienced. We began our meetings with a Normal institute at the State experiment station, at Geneva, lasting three days, which was followed by one at the agricultural college at Cornell University for the same length of time. Immediately following these, our men began the regular institute work, and were in the very best condition for a strong winter's campaign. Our first meeting was held November 4 and we closed on March 19, holding 267 meetings; of these, 100 were one-day meetings, 163 two-day meetings, and 4 were three days or more. One thousand one hundred and fifty-four sessions were held, and the total attendance was 64,347. This shows a slight dropping off from the year before; still, when we take into consideration the fact that the winter of 1903–4 was the most inclement one that New York has experienced in years and that at many of our meetings the roads were in an impassable condition, so that the attendance dropped down to almost nothing, some sessions having been lost entirely, I believe that we can report progress. We held institutes in every county in the State, except Richmond and Kings. One of the most successful that was held was a special horticultural meeting held on Forty-fifth street, in New York City. Our appropriation is the same that it has been for a number of years, $20,000, with no receipts from outside sources. Aside from these regular institutes, quite a few summer meetings and independent institutes were held, with an attendance of something over 35,000, giving us practically 100,000 for our attendance for the year.

We still adhere to our system of central management, sending from two to six speakers to each meeting and taking up the greater portion of the time with the State speakers, our local people being far better pleased with this than with any other system. Our special boys' and girls' sessions were very successful, and we find that we are interesting a large number of young people in taking a higher agricultural education. We discourage the idea of exhibits of implements and products at our meetings, but do wish to have a small display to be used in decorations.

The period devoted to the question box is one of the features of New York's institutes, and an examination of the questions which were all sent to the central office at the close of the meetings last year would indicate the wide range of the subjects discussed. New York State's agriculture is more varied than that of any other State. Our people are engaged in every line of special work, and in some sections of the State we have given up an entire session to such subjects as growing violets under glass, rose culture, growing carnations, commercial cabbage growing, growing sugar beets, and many others, to say nothing of the more general subjects which come up. For some years we have been holding special poultry institutes, special horticultural institutes, and special bee-keepers' meetings, and these are increasing in attendance and interest each year and are among the most profitable features of our work. On the whole, the institutes have never been more popular in New York than they are at present, and we have more applications on file already than could be gratified in four years with our present appropriation.

NORTH CAROLINA.

By Tait Butler, *Raleigh*.

Farmers' institute work in North Carolina is supported by and is under the control of the State department of agriculture.

During 1904 institutes have been held in 60 counties of the State. This is probably twice the number held in any previous year. On the whole, these institutes have been comparatively well attended. In fact, in most of the counties where institutes were held last year the interest manifested and the attendance this year have been such as to give great encouragement for the future success of the work.

No record of the attendance at the institutes was kept previous to 1903, but I am certain that during 1901 and 1902 it did not average over 100. During 1904, while many more institutes were held, and quite a number of these in the sparsely settled mountain region of the State, where institutes had rarely or never been held before, still 5 institutes had an average attendance of 510 each, 12 an average of 405 each, 29 an average of over 300 each, and the whole series of 60 had an average attendance of 203.

Three of the 60 institutes were of two days' duration, with two sessions each day; 55 were one-day institutes of two sessions each, and 2 were of one session each.

Twelve speakers were employed from the State department of agriculture, experiment station, and agricultural college; the State department of agriculture and experiment station furnishing nearly all of them. In addition, about 20 local unpaid speakers were used, principally at the two-day institutes.

The cost of holding these 60 institutes, including advertising, traveling expenses, etc., but exclusive of salaries, was about $1,550.

Nominally the commissioner of agriculture is director of farmers' institutes in North Carolina, but for the past two years I have had virtual charge of this work

Since no previous attempt at organization had been made, the plan of campaign adopted aimed at getting in touch with as many farmers as possible in each institute district or county.

A list of the leading farmers, numbering from 200 to 500 in each county, was obtained through the justices of the peace in each township, and to each of these farmers was sent a circular letter and a copy of the programme of the nearest institute. In addition, posters advertising the institutes were sent to each post-office and country store in each county and a copy of the programme published in the local and county papers. Schedules giving location and dates of all institutes were published in the leading daily, agricultural, and other State papers.

As a nucleus for a permanent local organization that will finally take charge of the arrangements for the institute and push the work to the point of making it of popular interest, a successful effort has been made to organize a committee of active farmers in most of the counties where institutes have been held this year. One active man was selected by those at the institute from each township in the county and a chairman chosen from among their number.

To a limited extent this plan of organization was adopted last year and this year. Our most successful institutes have been in cooperation with and through the assistance of these local institute committees.

NORTH DAKOTA.

By E. E. Kaufman, *Bismarck.*

The total number of institute meetings in North Dakota during the past year was 46. Twenty-three were one-day and 23 two-day meetings, making a total of sixty-nine days of institute work, holding 151 sessions. The attendance at all institutes was 13,567. The method of computing the attendance was that suggested by this association last year. It has been our system to hold one and two day meetings with the same force, but owing to the larger number of speakers required for the two-day meetings I think this plan will be discontinued. It is quite likely that a series of two-day meetings will be held and then followed up with a series of one-day meetings. Mixing the two and one day institutes causes considerable rearrangement in the presentation of subjects by the speakers.

The total amount of money expended for institute work the past year was $4,367.76, of which $1,002.82 were spent in the publication of the institute annual for 1903. This would leave a balance of $3,364.94, out of which must be paid the salaries of the institute speakers, hotel expenses, railroad fare, advertising, stenographer, and all other necessary office expenses. The places where institutes were held were required to furnish a hall, properly heated and lighted, and assist in advertising the meeting. By this means the institute board was able to save some of the money appropriated by the State for more important work in connection with the institutes.

The total number of speakers employed during the institute season was 14. Five of these were from the agricultural college and experiment station and in some cases attended but two or three meetings. The regular number of speakers supplied for a two-day meeting was five, and as our one and two day meetings were not separated there was usually five speakers at each of the one-day institutes, which, in my judgment, is at least one too many.

Three series of institutes were held the past year. The first series opened December 1 and continued until the holiday period. The second series opened January 4 and continued until March 5. The third was a series of seven meetings held during the month of June. As before stated, the one and two day meetings were held in conjunction. In scheduling the institutes the institute board considered the applications on file, which numbered 75, and used their best judgment in locating the institutes. The schedule was so arranged that each institute was advertised four weeks in advance. Large posters were furnished the local committee by the institute board. Other methods of advertising were then suggested to the local committee, and in nearly every instance where the local committee was especially active the attendance was large and the interest correspondingly marked.

It was not especially planned to inaugurate any new lines of work, but one subject that was made particularly prominent at all meetings was that of dairy husbandry. For the first time in North Dakota institute work a woman speaker was added to the corps for a part of the meetings. This feature was so enthusiastically received that a woman speaker will be regularly attached to the institute corps and an effort made to have her speak at every meeting held the present year.

OKLAHOMA.

By J. B. Thoburn, *Guthrie.*

While farmers' institute meetings have been held in Oklahoma for ten or twelve years past, there was no attempt at systematic effort along this line, save what was put forth by the agricultural and mechanical college and experiment station, and, in the nature of things, the college faculty and experiment-station staff could not act in an organizing capacity in distant parts of the Territory. The board of agriculture was organized under the laws of the Territory December 18, 1902, and its office was opened at the Territorial capital April 1, 1903, since which time a systematic effort has been made to organize the institute work on a permanent and progressive basis. As constituted by law, the board of agriculture stands in very intimate as well as representative relationship to the farmers' institute, as the six members of the board are selected, two each year for three-year terms, by a meeting composed of one delegate from each chartered county farmers' institute. Besides the county institutes, which are organized under the provisions of the law, local institutes are also organized. These local institutes are usually permanent organizations also. During the twelve months ended June 30, 1904, there were 52 institute meetings held in the Territory, with a total attendance of 5,400. While the work is a new one, it has been welcomed by the people in nearly every community in which it has been introduced, and the farmers' institute workers, who have had the work in charge, feel greatly encouraged by the prospect. An effort will be made to establish permanent organizations in the Indian Territory as soon as the two Territories are united into one Commonwealth. The diversity of soil and crop conditions in Oklahoma, together with the composite character of its population, renders the necessity of effective farmers' institute work doubly apparent at this time. Public sentiment among the people generally and in the press is very favorable to the movement.

ONTARIO.

By George A. Putnam, *Toronto.*

In reporting the work of the farmers' and women's institutes for the past year I may state, in the first place, that the system followed for the past few years has proved to be productive of such good results that no material changes have been made for some time. The system followed was very fully explained by my predecessor before your convention of last year. It is impossible to give an exact and distinct report for the farmers' and women's institutes in all particulars.

The number of meetings held by the farmers' institutes during the past year was 833. Seven hundred and fifteen of these were under the direct control of the superintendent, while the others were special meetings gotten up by the officers of the institutes concerned. Of the 715, 599 were one-day meetings, 6 two-day meetings, and 104 consisted of single sessions, i. e., a session would be held in one place in the afternoon and another in an adjoining town or village in the evening. By holding the majority of meetings in the smaller towns and country places nearly every farmer in the province is given an opportunity of attending one or more meetings near his home. The local officers are requested to take part in the discussions and to induce the best farmers of the locality to be present and give their assistance in making the meetings a success.

The total expenditure by the farmers' and women's institutes amounted to about $40,000. Fourteen thousand nine hundred dollars of this was voted by the legislature of the province, while the balance was secured by special grants from county and township councils, membership fees (25 cents per annum), the running of excursions, etc. The proportion of the provincial grant used for women's institute work was about $3,500, the cost of printing the annual report was $736, and the balance of the Government grant—$10,664—was devoted to sending out speakers to farmers' institute meetings and defraying the general expenses of the office of the superintendent, including all salaries and wages.

The number of speakers employed was 65—43 men and 22 women. For the most part the speakers sent out to address farmers' institute meetings are practical farmers who have made a success in their special lines. Each deputation is composed of two speakers—a general farmer and a fruit man, a dairyman and a fruit man, a beef man and an authority on horses, or some other combination of speakers best suited to the district to be visited. The province is divided into sections and speakers selected who are thought to be best able to give the instruction desired in the several localities.

In sending out lady speakers the aim is to have at least one member of the deputation a person who has had practical experience on the farm and is well acquainted with rural conditions. The other member is usually one who has had training in a school of domestic science.

It is usual for the institutes to give special attention to some line or lines of work each year. During the past season the subjects of pure seeds and weeds were given prominence, and the good results following the campaign for a better class of seeds are quite apparent throughout the province. At a number of meetings the speakers arranged to have representatives of different kinds of live stock brought to the meeting, in order to demonstrate to their audiences the desirable and undesirable points of the animals under examination. It was usual also for those in attendance to be given an opportunity to place the animals in order of merit. The institute delegate would then criticise the judgment of his class and give reasons for his placing of the animals. This promises to be a very interesting and instructive feature of institute work.

The work and influence of the women's institutes has continued to expand, and the interest in the different districts is well maintained. The increase in membership during the past year has been about 20 per cent, while the attendance has more than doubled. The number of meetings held throughout the year was 960, and there were 1,848 papers read and addresses delivered. Two hundred and twenty-one of the meetings were arranged for by the superintendent, while the balance consisted of regular monthly meetings and special sessions arranged for by the officers of the institute concerned. Previous to the summer of 1903 the meetings of the women's institutes were held in conjunction with the farmers' institutes, but now it is general to have them entirely separate, except at a few places in the winter season, when joint sessions are held in the evening. Some of the more progressive of these institutes have an average monthly attendance of from 50 to 60 of their members, and the subjects dealt with embrace any and all subjects which make for the betterment of home conditions.

PENNSYLVANIA.

By A. L. Martin, *Harrisburg.*

The year's institutes ending June 1, 1904, may be fairly classed as carrying with them a larger attendance and higher degree of interest manifested on the part of the great mass of farmers of the State than in any previous year. There were held in all 325 days of institute, divided into 804 sessions, with an average attendance per session of 180. The State college and experiment station supplied Prof. George C. Butz to do institute work fourteen days and Prof. M. S. McDowell forty-eight days, making a total of sixty-two days' service rendered institutes by the State college and experiment station, in one of the five sections which were in progress at the same time. Those representing scientific agriculture attending the other four sections were Prof. R. L. Watts, Scalp Level, Pa.; Prof. Franklin Menges, York, Pa.; Prof. Wells W. Cooke, Washington, D. C., and Dr. I. A. Thayer, New Castle, Pa.; these last four representing 272 days. The State appropriated for carrying on the work in 1903–4, $17,500. There were employed in all 57 lecturers representing the State and 339 local speakers, or persons from the locality where institutes were held, who joined with the State force in giving instruction. Amongst this number were most of the county superintendents of schools, who attended our educational sessions and addressed the institutes on one of the most vital questions, namely, the importance of rightly directed education for the farming people. A farmers' normal institute was held at Bellefonte, Pa., October 11–15, 1905, at which prominent institute instructors were present from adjoining States. The United States Department of Agriculture favored us with the presence of D. J. Crosby, who gave an illustrated lecture on Nature Study and Agriculture in the Public Schools. Prof. W. G. Johnson, editor of the American Agriculturist gave an address on The Art of Instruction as a Science. Mr. T. D. Harman, editor of the National Stockman and Farmer, made an address on The Influence of Local Institute Workers. Prof. John Hamilton, farmers' institute specialist from the National Department, Washington, D. C., presented a paper on the subject Normal Schools of Agriculture for Institute Workers. The success of this meeting is largely due to the Pennsylvania State college and experiment station for instruction on the lines of soil improvement, fertilizers, animal industry, fruit culture, dairy instruction, etc. As a result of this meeting a more uniform instruction has been carried on the past year throughout the State, and year by year it is becoming more manifest that a knowledge of agricultural chemistry and botany is an essential equipment which the institute instructor must possess in order to give the best instruction at farmers' institutes; that is, this knowledge coupled with actual practice and experience upon the farm. In brief, the Pennsylvania farmers' institutes are multiplying rapidly their field of usefulness and opening up the way for the adoption of the most approved methods of agriculture.

QUEBEC.

By C. A. Gigault, *Quebec.*

Agricultural lecturers during year 1903–4: W. Grignon, O. E. Dalaire, Gustave Boyer, Henri Groulx, Gustave C. Dubuque, W. P. Nelson, L. E. Carufel, George Moore, and Moise Bazinet.

Amount paid for fees, traveling expenses, etc., $6,745.64. Moreover, traveling expenses of lecturers coming from Ottawa to treat special questions and to whom traveling expenses amounted to more than $800 were paid by the Quebec government. Number of lectures, 431; attendance, 53,000.

TENNESSEE.

By J. B. Killebrew, *Nashville.*

I am not authorized to represent Tennessee on this occasion, but Mr. Ogilvie, the present commissioner of agriculture for Tennessee, is absent, having met with a severe bereavement, and I would like to respond for Tennessee, in order that the State may not be unrepresented.

The biennial appropriation for farmers' institutes in Tennessee is $5,000. The institutes are held in about ten counties of each of the three natural divisions of the State.

Generally there is a large attendance, and that attendance is due as much to the interest felt by the farmers of the State as to another thing that I hope every single institute will be able to get, and that is the cooperation of the railroads. Two of the railroads of the State during the past year and the year before gave free transportation to every institute held in the State on their lines, and this, of course, has resulted in a very large attendance, and has brought the railroads and the farmers into better relations.

In reference to the teaching of agriculture, I may say that as early as 1878 the legislature of Tennessee authorized agriculture to be taught in the public schools there; also elementary geology, supposing that the study of that lies at the foundation of a knowledge of the soil. The subjects embraced in the programmes of the institutes are very extensive, embracing almost everything, from fertilization to the public roads. The public roads especially have claimed a great deal of attention, although the State has probably as many good public roads as any other State in the South. The subject of fertilizers is always on the programme. I suppose that results from the fact that within the last eight or ten years great beds of phosphates have been discovered in the State, and a great deal of fertilizer is used. For this reason the advantages of the use of fertilizers always forms one of the subjects treated in the institutes.

The feeding and care of live stock during the winter and summer and the raising of forage plants for this purpose also receive attention.

WEST VIRGINIA.

By J. B. Garvin, *Charleston.*

Since the last meeting of this association, which includes the greater part of two seasons' work, 152 institutes have been held. Of these, 37 were one-day meetings, usually of two sessions each, and 115 two-day meetings of three to four sessions each. The estimated attendance reported was 18,729.

These institutes were conducted by 21 instructors, part of them being selected from among the most intelligent practical farmers and by members of the board. We also employ young men who have either attended or are graduates of the agricultural college. The aim is to encourage and help develop such young farmers, and those who show aptitude for the work are retained on the force. We also receive valuable assistance from the college of agriculture and some from the experiment station. Two speakers and one assistant are assigned to each section, which usually extends for a period of from two to three weeks.

For the period embraced in this report, $5,779.69 was expended for institutes in the way of printing programmes, posters, secretaries of local institutes, and per diem and expenses of instructors. The instructors are paid $4 per day and expenses, and the assistants receive $2 to $3 per day and expenses. Two speakers were employed from outside the State to assist in the institute work for the season just closed, for which we paid $5 per day and expenses.

The plan of having requests by petition from the different localities was adopted a year ago, which requires that a petition be signed by at least ten farmers who will agree to take an active interest in helping to work up the meetings. This petition is filed with the superintendent to be used in making up the schedule.

The schedule is arranged by a committee appointed by the board, consisting of two of its members and the superintendent. At the regular semiannual meeting of the board in April the committee arranges the schedule of institutes and assigns the speakers.

So far we have never held an annual round-up meeting, but last winter organized a State Farmers' Normal Institute Society, for the purpose of bringing together farmers' institute workers and those who might be interested and hold a regular school of instruction and methods for a week or ten days.

The next meeting will be held in Charleston, beginning January 23, 1905.

WISCONSIN.

By Geo. McKerrow, *Madison.*

One hundred and one meetings and eleven cooking schools were held in Wisconsin, with an aggregate attendance of 51,000. Sixty thousand copies of Farmers' Institute Bulletin No. 17, 320 pages, were issued and distributed to the farmers and libraries of the State. The interest in institute work was never better, and we believe the work done was fully up to or even ahead of that of previous years. Short talks and long discussions were the rule and seemed to bring out the points of excellence upon each subject much better than longer talks and shorter discussions.

The subjects discussed at these meetings covered the whole range of Wisconsin agriculture. Dairying in all of its phases, horse, cattle, sheep, and swine husbandry, poultry, horticulture, grass and grain growing, general management of farms, farm buildings, good roads, and household economy have all been treated under different headings so as to cover the whole range of our agriculture.

REPORT BY THE FARMERS' INSTITUTE SPECIALIST OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

By John Hamilton, *Washington, D. C.*

The work of the farmers' institute specialist of the United States during the past year has for the most part been in the direction of securing information as to the condition of the institutes in the several States and Territories. A complete list of the names and post-office addresses of the farmers' institute lecturers of the United States in the employ of the State directors has been obtained and published. They number over 900, and of these the personal history of about 700 has been obtained, which shows that they are men thoroughly qualified by education and experience for the work that they have assumed.

Lists of the names of the lecturers were furnished to all of the experiment station directors of the United States, accompanied with the request that they send to each lecturer copies of their lists of bulletins. They were also requested to supply the lecturers, upon application, with copies of such bulletins as they might desire. An arrangement was also made with the Division of Publications of the National Department of Agriculture by which the monthly list of publications would be regularly sent to these State lecturers, from which they would be at liberty to select bulletins in which they are specially interested and receive them by addressing their requests to the farmers' institute specialist.

Blank forms containing queries addressed to the State directors were prepared and sent out. The information thus obtained was collated and published in the Annual Report of the Office of Experiment Stations for the year ended June 30, 1903. The statistics show that 3,179 institutes were held during that year and that there was a total attendance of 904,654 persons at the institute meetings. The appropriations for the year aggregated $187,226. The total number of days of institutes held during the year amounted to 4,880, and the entire number of sessions was 9,570. The cost per session ranged from $3 to $82, the average being $16.85. The institutes cost at the rate of $39 per day.

The reports of the State directors for the year ended June 30, 1904, have been received, with the exception of three States. Those thus far received show an attendance of 798,228, and that there were held 3,086 institutes, made up of 9,940 sessions. The appropriations for institute purposes for the year amounted to $197,711. The number of one-day institutes reported was 1,564; of two days, 1,448, and of three or more days, 74. The number of lecturers reported on the State force was 953. Of this number 345 were officially connected with the agricultural colleges or the experiment stations.

A number of State directors did not reply fully to the questions asked, and consequently it is impossible to make comparisons that will embrace all of the States. Taking, however, those who have answered the questions, we find that while there has been a considerable increase in the amount of money appropriated for institute purposes, the attendance has fallen off about 57,000. Some of the facts, in a comparative way, giving data for the year ended June 30, 1904, as compared with the reports from the same States for the year which ended June 30, 1903, may interest you. The total attendance for 1903, in the States referred to, was 850,032; that for the year 1904, 793,028. The number of institutes held in 1903 was 2,904; the number held in 1904, 3,086. The number of days of institutes held in 1903 were 4,545; the number of days held in 1904, 4,319. The number of sessions held in 1903 was 9,056; in 1904, 9,673. The appropriations made in the States whose reports are comparable amounted in 1903 to $176,726; in 1904 to $197,711. Notwithstanding the falling off in attendance, the number of sessions held, which is the proper unit in computing the amount of institute work, was 617 more than in the previous year, and the amount of money contributed for institute purposes in the States compared was $20,985 more in 1904 than in 1903.

Your attention is called to the fact that there has been a falling off in a number of older institute States, both in the number of sessions held and in the total attendance at the institutes. Delaware, Florida, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, West Virginia, and Wisconsin show a decreased number of sessions in 1904, amounting to 778, and a diminished attendance amounting to 175,818. It may be well for the institute workers connected with this association to seriously consider whether there is not new needed some new form of institute organization in order to prevent the apparent falling off in interest which the reports from the States mentioned seem to indicate.

In the discussion following this paper it was suggested that the falling off in attendance reported might be due to the severe winter weather of the past year in the more northern States and provinces, and also to the fact that actual counts of attendance have taken the place of estimates. It was also shown that the decrease in the number of sessions of farmers' institutes was due in part to the bad weather and the inaccessibility of some of the places chosen for meetings.

PLACE OF NEXT MEETING.

Mr. J. G. Lee, of Louisiana, presented a cordial invitation to the association to hold its next meeting at Baton Rouge, which was accepted.

A telegram from F. E. Dawley, of New York, expressing regret at his inability to attend the meeting and extending good wishes to the association, was read by the secretary.

The convention then took a recess until 2 p. m.

AFTERNOON SESSION, WEDNESDAY, OCTOBER 19, 1904.

The convention reconvened at 2 o'clock p. m., Mr. Kaufman in the chair.

The following topics were discussed: The Relation of the Agricultural College to Farmers' Institute Work (see p. 53), Advertising Farmers' Institute Meetings (see p. 56), and County Organization for Institute Work (see p. 59).

APPOINTMENT OF COMMITTEES.

The chairman announced the appointment of the following committees:

Committee on nominations—Messrs. Amoss, Easterly, and Clinton.

Committee on resolutions—Messrs. Latta, Conner, and Putnam. (For reports of these committees, see p. 45.)

Thereupon, at 4.20 p. m., the convention took a recess until 7.30 p. m.

EVENING SESSION, WEDNESDAY, OCTOBER 19, 1904.

The convention met at 8 o'clock in the Illinois State Building, Vice-President Kaufman in the chair.

The CHAIRMAN. Those who were at the Toronto convention last year will remember with pleasure the address of Mr. James, of Ontario. He is with us again this year, and I take pleasure in introducing him to this audience.

ADDRESS OF HON. C. C. JAMES,

Deputy Minister of Agriculture for Ontario, Canada.

Mr. PRESIDENT, LADIES AND GENTLEMEN: I feel it is no small privilege, no small honor, and no small responsibility to be permitted to address a gathering which represents the greatest industry on the continent of America. There have been conventions of various kinds on the Fair Grounds here in the city of St. Louis, and I think you will perhaps allow me to say that there is none with wider interests and having greater possibilities than that with which you are connected.

A few of us have come down from the country to the north of you, from Canada, to take part in these deliberations, that we may get some help and inspiration from them, and perhaps be able in small measure to give you in return some little help. On this occasion it is peculiarly appropriate that Canada should be represented in any convention that should be held in St. Louis. Perhaps all of you may not be aware that this city of St. Louis was founded by Canadians. That was a good many years ago, and perhaps the impress of those early French Canadians may not be very noticeable here now.

I bring to-night not merely the greetings of the Province of Ontario, but also that of the great agricultural industry of the Dominion of Canada, that which is paramount in our great country's life. You are more particularly interested in the farmers' institute work of agriculture than any other of its aspects, and I would like to say at the outset that in Canada, and especially in Ontario, we owe a great deal to the farmers' institute movement. We got it originally from you, and in some respects we think we have improved on what we got. We changed it and adapted it to suit our own conditions, and it has been the great, potent influence in helping us to develop the great agricultural interests of our Province. It was the first means whereby as a department we got a grip upon the farmers of our Province. It was the first means whereby we set into operation those forces and movements which have been so helpful in developing that great industry. Up to that time agriculture was more or less carried out in a sort of perfunctory way. The interest was of a mild type. It is only since we have begun to develop the farmers' institute movement that, so to speak, we have put life into the agriculture of our Province and have brought it along the line of high development and prosperity, about which I shall speak to you for a few moments.

The farmers' institute movement has been the key to any success we have had. We have adapted its means and methods to other lines of organization. Through it we have made our agricultural college the most progressive and most successful educational institution in the country. Through it and by it we have organized those special organizations, associations that have been given special work, and by it, as I have said, we have at last a grip upon the farming community and have got their confidence, so that any undertaking we now have in hand we can carry out knowing that we will have the hearty cooperation and sympathy of our farming community.

The history of agriculture in the Province of Ontario has been very much the history of agriculture in some of your northern States. Briefly, let me refer to it—and you will pardon me if in my address to-night I seem to be talking a little more than, perhaps to some, might seem necessary about our own work, but it is one's privilege, and I suppose one's duty, to talk about that with which he is best acquainted.

When the Province of Ontario was first settled it was, like the Northern States, a forest wilderness, and those who went in to make their homes had to cut them out from the primeval forests. In the early years—in the early decades—in the early generations, in fact—the products of the forest were to a large extent the products of the farm. As, however, the forest melted away before the pioneer's ax and the fields became cleared so that they could be sown with different crops, then wheat became king where the forest had reigned supreme before. Gradually, however, as the population increased, but especially as there came from the lands across the sea an increase to our people, there sprang up—there was added to our grain production—the great live-stock industry, which gradually grew and assumed such large proportions. This was quite a step forward. And then, succeeding that, we began to specialize. And just as we were getting nicely under way and our agriculture was apparently making satisfactory headway, something happened which, perhaps, now we can refer to even on this side of the line without any hesitation whatever, but which, at that time, was a very sore point with us. Just as our agriculture was apparently, I say, getting into a prosperous condition there was raised between your country and ours that high wall of separation which still remains—the great tariff wall. On account of the raising of that wall the farmers of Ontario were placed in a somewhat desperate condition. They had built up a large market in the American cities for their barley, a large market in sheep, a large market in eggs, a large market in horses. They had been looking continually to the cities to the south for their market, and all at once—all in a day, so to speak—that market was cut off by the rearing of that tariff wall. Our farmers naturally were very much disturbed in their condition, and their future at first seemed to be almost hopeless. It was at this time, however, that our farmers' institute work was making very rapid progress, and every person who had any concern in connection with the agriculture of our country was compelled to give most serious consideration to the depressed condition of our farmers.

Being shut off from this market to the south we naturally had to look across the Atlantic for a market, and by the assistance of our farmers' institute we began to build up a new agriculture in the Province of Ontario. Instead of raising grain for export we began to turn that grain into finished products—to produce beef and bacon and cheese. Gradually we emerged from that slough of despond into which we had been thrown, and I want to give you here the results in a few brief figures. It took some time, of course, to produce results, but here are the results in a few figures, which will show you how successfully the whole agriculture of the Province of Ontario has been changed and how we have had it placed upon a much surer foundation than it was before.

In the year 1896 the farmers of the Province of Ontario produced in these three products to which I have referred 31 million dollars' worth—beef, bacon, and cheese. Last year these three products aggregated 65½ million dollars. Now, an industry that will increase its output by 34½ million dollars in seven years must certainly be in a very successful and prosperous condition.

The effect of that has been that for the last six or seven years—more especially for the last four years—we have enjoyed throughout the Province of Ontario a prosperity that has never been surpassed, that has never been equaled before. We have not had that stress of commercial conditions which I believe you have felt here to the south of the line. The times have been good and they have continued good, and all through our Province at the present day you will find that these conditions are keeping up and that everybody is in a prosperous and happy state. This we attribute, to a large extent, to the change that has been brought about in the agricultural conditions of the country. We have changed our condition from that of the production of grain for export to the production of those finished articles to which I have made reference—namely, beef, bacon, and cheese. At the time it seemed to us rather harsh treatment we were receiving, and though darkness and despair seemed to be ahead of the farmers of Ontario at the time you can see now that good has come out of it and our farmers are in a more prosperous condition than they ever were before.

Now, how has this been accomplished? How have we been able to turn our farmers from grain production to the production of those finished articles? Mainly, as I have hinted, by means of our general farmers' institute work. Through it we have carried on year by year a missionary enterprise which has worked in season and out of season, slow in producing results, but sure; and from our farmers' institutes we have organized on a similar basis those special associations which have done so much. For instance, we have organized provincial cattle breeders' associations and we have organized sheep breeders' associations and we have organized swine breeders' associations. These have carried on the work intrusted to them in connection with those three lines, and then they have amalgamated in a successful fair, which we call our winter fair. In reference to our bacon industry, we can attribute success more to the farmers' institute than anything else. There the whole thing was carefully planned and carried out successfully from the beginning. The building up of the great bacon industry to the north of you has been largely due to the missionary work carried out through the farmers' institute.

The development of our cheese industry can be traced back to a similar line of work.

And so I say that the position we are in to-day is largely due to the farmers' institute work, which we adopted in its original form from the farmers' institute of the United States and which we adapted to the circumstances and conditions which we found necessary in our own province. Not only have we greatly increased the annual output of the farmers of the country, but as a consequence we have materially increased their capital. If the capital of the country is more productive, of course it will increase in value, and the consequence has been that during the last six or seven years farm values of the Province of Ontario have been rising steadily, an increase in value amounting to $187,000,000. So when I say that agriculture is paramount with us, that it far outshines all manufacturing industry, you will see I am making statements that are well within the mark, and in them you will see the secret of the success we may have had along other lines.

As I walked around the grounds and tried to take in the immensity of the exhibition here gathered together from America and all parts of the civilized world, as I went through the Transportation Building and the Manufactures Building, and so on, I could not help but think that after all enough of the success of this great fair and the exhibition that has been made here has not been attributed to the agriculture of this country. Had it not been for the rich fields of the West, and the center, and the South there would have been no great demand for these magnificent transportation departments. Had it not been for the rich products of those millions and millions of fertile acres the great Manufactures Building and the Varied Industries and Liberal Arts buildings, and so on, would have found no place here. It seemed to me that in the planning of these buildings, in the first place, those who did the work hardly gave that prominent place to the great Agricultural Building that it rightly and properly deserved. Perhaps that comment may not be fully appreciated by all; but it seems to me that the place of honor in an exhibition of this kind properly belongs to that which is the foundation of all else.

What about the great work with which we are concerned, that more particularly known as the farmers' institute work of this country? As I have said to you, we have found it the key to success with us in our agricultural work. We claim to have made no little success in our agricultural department, and we have used the farmers' institute work from the very start. It was the means whereby we got hold of the farmers and got their confidence. And I would simply say to you, if any of you are meeting with any discouragements, feeling that you are not making that progress in your farmers' institute work that you should make, that it takes a long time to get a grip on the farmers of any community; but that after all the farmers' institute is the best way I know of of getting that grip which is so important and so necessary.

The next movement that we are about to undertake in connection with the agricultural work of our country to the north is that of agricultural education. We have been fairly successful with our farmers' institute work, and through it we have brought a large measure of success to our agricultural college; but it has always seemed to me that outside of these new forces, outside of the farmers' institute work, and outside of the agricultural college there is an enormous field yet to be developed, a field that has hardly yet been touched upon and that after all is the most important of the three.

We have within the last three months made a very important change in the educational possibilities of our Province. It has taken a long time, much talking, much and long discussion, and we have had a great deal of discouragement before we succeeded in coming to the point we have at last reached. We have at last gotten agriculture recognized upon the curriculum of our public school system on the same basis as other subjects that have been placed there. We have had the opportunity before of having agriculture taught to a limited extent in some of the senior forms of the public school, but never until this year have we been able to provide that agriculture may be brought into the public schools from the very start, and that it ought to have its place in the first form just as well as in the last form. It is a most remarkable thing how the agricultural questions of this country—and when I speak of this country I mean the United States and Canada—how the agricultural questions in North America have been approached, so to speak, wrong end to. In the olden days the great educational facilities were all confined to the monasteries, and gradually, as they opened their doors, the men who were to be fitted for the professions were admitted. Education for the common people was not at first considered necessary or important. Gradually, however, the educational facilities have been extended, and now everybody can get an education for that which he requires. When we came to apply this statement or this principle to our educational work, see again how we have turned it round. The first great movement in favor of agricultural education has been known as the farmers' institute, now to be found in every State and every Province of the Dominion. And yet take yourselves as members of the farmers' institute. You as young men, you as young women, I venture to say, had little or no opportunity to get what might be termed an agricultural education, an education that particularly and specially fitted you for your work. You had become men and women before you were enabled to take part in this great agricultural movement. That is, we have begun our great educational movement, our great educational improvement, by trying to improve the men and the women of mature years. You say, What about our agricultural colleges? You have only to consider this: That the agricultural college can merely touch the fringe of the great agricultural community. You have, in your State, for instance, an agricultural college capable of accommodating 200, 300, 400, or even 500, we will say. Calculating the number of farmers that you have in your State you will see how many farmers' homes you can directly touch through the agricultural college. For instance, in the Province of Ontario we have 175,000 farmers. Last year in all our classes, general and special, we had an attendance of over 700. Now, take 175,000 farm homes. There will be at least 350,000 farmers' sons and daughters. What are the 700 hundred out of the great mass of 350,000? It is simply touching one young man here and one young man there, doing a very important work and, perhaps, the best work that can be done, in teaching these young men and then sending them out, back to teach their neighbors, putting them in touch with their neighbors and helping on the movement; but what of the ninety and nine, so to speak, that have not been reached at all? We have reached the farmers through the farmers' institutes, and we have reached the farmers' wives through the women's institute, and we have reached some of the boys and girls through the agricultural college. But if we are to do this work thoroughly and well, if we are to permeate the whole agricultural mass of the community, we have to get down lower, we have to get our work more widespread, we have to get into the public schools, not at the fifth form or the fourth form, but at the second and first forms, and begin the work from the ground up.

Who would think of beginning the erection of a building by putting on the roof first and then building downward? Now, is not that just what we have done in our agricultural work? The wonder is we have succeeded as well as we have in the work, beginning as we have in this irrational way of doing the work. Perhaps it was the only way—the best way in which we could begin. But we have made our beginning; we have proven what can be done. Now, it seems to me that all through the States of this country and through the Provinces we should lend our efforts to this one great question of how we can rationally and scientifically and properly begin the upbuilding of our agricultural community by educating the boys and girls, rather than the fathers and mothers.

That is one question that we ought to take home with us and work out as best we can in our various communities through our farmers' institutes, and you will find, as we have in our own Province, that it is a difficult matter to get the farmers of a community so aroused to the importance of a question that they will take hold of it as a live issue. Put a question of that kind before the men of the cities—the financiers, the bankers—and they will agree with you at once; they will say, "Of course, that is it; that is what you ought to do; that is what is right and proper," because these men recognize better than anybody else that it is from the farms that their wealth ultimately comes, and that with an enlightened farming condition they will succeed better than if the country is given over to men uneducated and undeveloped. But when you come to carry out a campaign of that kind in connection with the farmers themselves you will be met at first with indifference, if not with opposition. We found it so with us. But you must keep at it and at it and at it. The agricultural community of your State, as of our Province, is slow to be moved. It takes a longer time to consider questions of this kind, but once you get the agriculturists of a community moved nothing will stop them, and if we can only get this one question ground into their very being—that an agricultural education must begin with the boys and girls at the earliest age—as soon as we can get that kneaded into their fiber and their very being then it will not take very long to work out success even in the most irresponsive State in the whole of North America.

I stated a moment ago that in connection with this agricultural movement we must expect results to come slowly. We must not try to push matters too rapidly, and we must not look for results in too short a time. Frequently we meet workers, experienced and others, who are apt to become discouraged in their work. If there are any people in this country who are in need of inspiration to work or need to have it with them all the time it is the men who are concerned with the farmers' institute work of this country, the men who are trying to uplift and upbuild the agricultural interests. There is laid upon them a responsibility that is unequaled along any other line that I know of. I sometimes feel so overwhelmed by the responsibility of this work that I hardly know what to say about it or how to properly present it. There is, to my mind, no calling that comes so near to that of the man bent on religious work, great moral missionary work. There is no man who comes so near to that as the man who is trying to educate the farming community, trying to help work out in the best way possible the agricultural interests of any Province or of any State.

Did you ever consider the importance of this in its relationship? For instance, here is a man who takes up some great manufacturing line of work. He throws his whole mind, soul, and body into it, and he makes wonderful success of it. That success results in the accumulation of a large amount of money. Now, that man by the accumulation of that large amount of money is benefiting himself, his family, and perhaps his immediate associates. He can not keep his money; of course it must be spent; but to a large extent the benefits of that accumulation are narrowed down to the man and his immediate relations. He may pick that up and carry it off to some other place; it is portable; it is not tied down. But just consider what the agricultural missionary is doing. He is helping to develop the farmers of a community. He has his hands, so to speak, on the agricultural work of a large area, a large district; he is helping this farmer and the next farmer and so on down the whole line, helping them to improve their farms, their buildings, their style of agriculture, so that gradually they become more prosperous. As the farmer becomes more and more prosperous you are, so to speak, tying him more and more to the land; you are putting him in a position where he is becoming a more and more important citizen in that country. You are at the same time helping in the diffusion of wealth, which, after all, is better than the accumulation of wealth in the hands of a few persons in the State. In connection with this agricultural work, then, those two things, it seems to me, ought to be kept in mind, and perhaps they will enable us to tide over some of our periods of despondency. In uplifting the agricultural community you are in the best way possible encouraging the diffusion of wealth, and you are at the same time building up a citizenship that makes for the best interests of the whole country. You are building up men who will be the last of all to rebel against constituted authority; you are building up men who will be attached to their own homes; you are building up men who are at the foundation of all the other industries in the country; you are building up, as a rule, men who are strong in moral character and strong in moral fiber.

If we can only get that aspect of the question clear in our minds—that in this great agricultural movement we are not simply working to build up men's dollars, that we are not simply working to make our country wealthier than some other country, but at the same time by means of this work we are helping to build up a citizenship—we are helping to build up a class of people; a yeomanry, if you wish to call them that, a great class of people, who will be the backbone of that community, who will add to that community those great moral forces which are so important in forming great public opinion. If you will keep that before you, you will go on with your work with fresh vigor and fresh inspiration and fresh hope of success.

Not to talk at any greater length, I trust, in this work wherein we of the North and you of the South can cooperate and where tariff walls and other things count for nothing in the consideration of these great agricultural questions—I trust that you will get through our movement whatever is beneficial and that you will allow us to get from you whatever is beneficial to us, and that you will cooperate as we have done in such associations as we have here, and that the great agricultural questions of Canada and the United States will be worked out peacefully, quietly, and well, so that there may grow up on both sides of the line a happy, contented, and prosperous people; for so long as that is the case, no matter what politicians or others that may wish to stir up trouble may say, so long as we have a happy, prosperous, agricultural people, so long we shall be at peace and we shall help to work out the great destinies that Providence has ordained in connection with the North American continent.

The convention was then entertained informally by Illinois delegates, and after refreshments had been served the meeting adjourned to reconvene Thursday morning, October 20.

Morning Session, Thursday, October 20, 1904.

The convention met at 10 o'clock a. m., Mr. Kaufman in the chair.

Papers on Women's Institutes were presented and discussed. (For papers and discussion on this subject, see p. 63.)

Separate Sessions of Institutes for Women.

Mr. Creelman, expressing his high appreciation of the papers presented by the ladies and of the value and interest of their contributions to the discusions, said that in his opinion arrangements should be made for separate women's sessions as well as union meetings.

After considerable discussion of the subject by Messrs. Gregg, Latta, Newberry, Creelman, Greeley, and Conner, Mrs. Easterly and Mrs. King, it was voted that the men retire so that the ladies might hold a separate meeting to consider the subject. (For action of this meeting, see p. 63.)

Before taking the action ordered the convention received and accepted an invitation to visit the Nebraska exhibit in the Agricultural Building of the Exposition after adjournment of the day's session.

At 12.15 the convention took a recess until 2 p. m.

AFTERNOON SESSION, THURSDAY, OCTOBER 20, 1904.

The convention convened at 2.25 o'clock p. m., Mr. Kaufman in the chair.

The secretary read the report of the meeting called to consider the advisability of forming separate women's institutes, as follows:

Mrs. S. Noble King, of Illinois, was called to the chair, and Miss Blanche Maddock was appointed secretary.

The general opinion of those present seemed to be in favor of appointing a committee to confer with the executive committee of the American Association of Farmers' Institute Workers regarding separate sessions to be held.

It was moved and seconded that a committee be appointed by the chair for that purpose.

The following committee was appointed:

Mrs. Joseph Carter, Champaign, Ill.; Mrs. Bertha Dahl Laws, Appleton, Minn.; Miss Blanche Maddock, Guelph, Ontario; Mrs. Henry M. Dunlop, Savoy, Ill.; Mrs. J. W. Bates, Broad Ripple, Ind.; Mrs. S. Noble King, chairman; Miss Blanche Maddock, secretary.

The report was accepted and referred to the executive committee of the association.

Papers and discussions on the following subjects were then presented: The Relation of the Experiment Station to Farmers' Institute Work (see p. 71); How to Train the Farmers' Institute Worker (see p. 78); and New Problems and Methods in Institute Work (see p. 81).

REPORT OF COMMITTEE ON NOMINATIONS.

Mr. AMOSS. The committee on nominations reports as follows:

President—J. C. Hardy, of Mississippi.
Vice-president—E. A. Burnett, of Nebraska.
Secretary-treasurer—G. C. Creelman, of Ontario.
Executive committee—J. G. Lee, of Louisiana; F. H. Hall, of Illinois; L. A. Clinton, of Connecticut.

On motion, duly seconded, the report was accepted.

REPORT OF COMMITTEE ON RESOLUTIONS.

Mr. Latta, from the committee on resolutions, made the following report:

Your committee appointed to formulate the sentiments of this meeting respectfully submits the following resolutions:

(1) That we regret that temporary indisposition has prevented our president, B. W. Kilgore, of North Carolina, from attending this meeting, and we trust he may soon recover his usual health and vigor.

(2) That we are pained to learn of the sudden death of our fellow institute worker, H. F. McMahan, of Indiana, whose name appears on our programme. We tender sincere sympathy to the family and friends of the deceased.

(3) That we heartily commend the thoughtful, scholarly, and eminently practical addresses and talks of Mr. C. C. James, deputy minister of agriculture for Ontario, Canada; Mr. Frank H. Hall, superintendent of farmers' institutes for Illinois, and Mrs. S. Noble King and other ladies, on important phases,

purposes, and accomplishments of the farmers' institute work. We trust that their addresses may have a wide reading by the general public and that they will be carefully read and applied by institute workers.

(4) That we recognize the great educational value of these annual meetings of the American Association of Farmers' Institute Workers in extending pleasant and profitable acquaintance among the workers, in giving up-to-date information as to the newest lines and best methods of work, and in pointing out the mistakes of the pioneers for the benefit of the inexperienced in this great field of practical agricultural education.

(5) That while we are justly proud of the success of the farmers' institutes in helping the farmer of yesterday and to-day, we recognize that we confront the more important and far-reaching work of training for enlarged usefulness, success, and happiness the farmer of to-morrow.

(6) That we note with pleasure the growing recognition of the fact that the school children must be inoculated with the leaven of agricultural and domestic science education, and we rejoice that already agricultural colleges, farmers, public school officials, and teachers are uniting their efforts with general and local institute managements to this end.

(7) That we are highly gratified to note the largely increased cooperation of the agricultural colleges and experiment stations in the farmers' institute work, as shown by the fact that over one-third of the State lecturers are from college and station staffs and that over 2,000 days of services were contributed by these workers during the past year.

(8) That we realize that a highly important mission of the farmers' institute is to sweeten the toil, render more effective the labor, increase the cheer, multiply the comforts and attractions, train, lift up, and inspire the inmates, and thus strengthen and hallow the influences of the home. We therefore rejoice in the progress that has been made in the preparation and training of the home makers of our country, and we hail with delight the favorable omens for a larger and better work at farmers' institutes in behalf of our mothers, wives, sisters, and daughters.

(9) That we appreciate the very effective work, encouragement, and effervescent good cheer of our genial secretary-treasurer, Mr. G. C. Creelman. We congratulate him on his promotion to the more responsible position of president of the Ontario Agricultural College, and we are very glad that his new duties will permit him to continue to serve the association as its secretary-treasurer.

(10) That we tender hearty thanks to our farmers' institute specialist, Mr. John Hamilton, for his instructive exhibit of illustrative material and for many thoughtful attentions; to Mr. F. W. Taylor, chief of the department of agriculture and horticulture of the Louisiana Purchase Exposition, for his kindly greeting and other courtesies; to the Illinois State Farmers' Institute for the privilege of holding one of our sessions in their palatial State building on the fair grounds, and for their very pleasant impromptu and informal reception tendered the members and friends of our association; also to the press for notices and reports of the several sessions of our meeting.

(11) That the secretary be instructed to furnish copies of these resolutions to the newspaper and agricultural press of the country.

Respectfully submitted by the committee on resolutions.

W. C. LATTA, *Indiana.*
G. A. PUTNAM, *Ontario.*
C. M. CONNER, *Florida.*

Mr. J. G. Lee reiterated his invitation to the association collectively and individually to come to the meeting at Baton Rouge, and assured them a cordial welcome.

Mr. Newberry invited those in attendance at the meeting to visit the Oklahoma exhibit in the Agricultural Building.

The convention then adjourned sine die.

PAPERS, ADDRESSES, AND DISCUSSIONS.

The following paper was presented by John Hamilton, farmers' institute specialist, of the Office of Experiment Stations, U. S. Department of Agriculture:

THE USE OF ILLUSTRATIVE MATERIAL IN INSTITUTE WORK.

It is unnecessary to occupy time in discussing the value of illustration in teaching. It is now agreed that no method of imparting information, whether by oral delivery or otherwise, is complete that does not provide for appropriate illustrations. The almost universal use of the cartoon by the public press, of the half-tone engraving by magazine writers and text-book authors, and of stage settings by theatrical managers, in which the story itself is represented by living actors, are all evidence of public appreciation and approval of the demonstration method in teaching. Whether the purpose be simply to amuse or, on the other hand, to impart valuable information, the illustration method is now adopted by those who are most successful, and the degree of success is usually according to the appropriateness of the illustrations and the skill with which they are presented.

PURPOSE OF THE INSTITUTE.

In the farmers' institute the purpose in presenting a subject at all is usually threefold—first, to interest the audience; second, to impart instruction, and third, to induce individuals to adopt and put into practice the truths presented.

The methods in use in accomplishing these ends are—first, a statement of the truths to be taught presented in such orderly arrangement as to develop the thought most clearly and to fit it for the comprehension of the hearers; second, illuminating the subject through illustrations, either verbal or by the use of objects, so as to create and maintain interest and fix the important points in the mind of the hearers.

MATERIAL FOR ILLUSTRATION.

The utensils used in illustration are numerous and quite dissimilar. Anecdotes, word pictures, amusing stories, intonation, gesture, are familiar forms of illustration within the reach of every speaker and are effective when discreetly and skillfully used. On the other hand, the delivering of stupid or worn-out stories, or for a speaker to intone, gesticulate, or pose in a studied or artificial way is to hinder rather than help his address. The individuality of each speaker enters quite largely into the question and is often such as to make proper and effective the use of a method or illustration by one man that would be inappropriate and perhaps altogether improper if presented by any other.

No doubt the purpose of the committee in assigning this subject was to call attention to illustrative material of an entirely different character from that which has just been referred to; to the use of objects or some visible form of demonstration that will both interest and instruct.

THE BLACKBOARD.

The blackboard is perhaps the most useful and convenient form of illustrative teaching that we have, provided the lecturer is fairly skillful in the use of crayon and has made judicious selection of the subjects to be presented. The gradual development of the diagram or picture under the lecturer's hand holds attention and gives time for the audience to study the details and hear the explanations as the work progresses. By this method the lecturer can withhold any part that he sees fit until the appropriate time for its presentation arrives, when, by a stroke or two, the complete outline sets forth the point to be illustrated with increased effect. Every institute platform should be equipped with a good blackboard, a stock of colored crayon, and an eraser, and every institute lecturer should acquire the art of using the blackboard with facility and comfort to himself, and with interest and profit to his audience.

THE LIVING OBJECT.

By far the most effective illustrative material is the living object. A live animal on the platform will furnish a text and hold attention as no other subject can. In many cases it furnishes both the material for the lecture and its illustration as well—in short, supplies a perfect subject in itself.

Who that has seen the famous horse Jim Key in the hands of his trainer, adding, substracting, and multiplying numbers, was not impressed to an extent that he can never forget; or that, as a child, saw the wonderful feats of the little canaries exhibited by Signor Blitz, was tired for a moment or has lost the delightful impression then received and has not had a greater regard for bird life ever since? A horse, a beef animal, a dairy cow, a well-bred rooster, or a prize hen, exhibited by a lecturer qualified for the work, will hold any audience for an hour as effectually as the most attractive play that the theaters present. A living model impresses one with the feeling that the lecturer is dealing with problems that are real instead of mere theories, with the feeling that we are in the presence of a most wonderful machine, whose marvelous properties the lecturer is endeavoring to explain, and not that of a mere inert and senseless form. The difference in interest between the living thing and the representative of that thing is that of the difference between the thrill one feels when going at a gallop upon the back of a well-bred and finely gaited horse, and the sensation of a ride on a wooden model in a merry-go-round.

THE USE OF SPECIMENS.

The next most effective method of illustration is perhaps that of the use of specimens of the article, duplicates of which, when they are of moderate size, can be passed around through the audience for examination as the subject is discussed. This handling and personal examination fixes the points in the hearer's mind in a way that he can never forget, and at the same time makes him confident that he will be able to recognize the article, whether it be an insect, fungus growth, variety of fruit, or other object, wherever he may meet it in the future. A balanced ration exhibited by using the forage itself in its proper proportions will be remembered much longer and be better comprehended than the presentation of the subject by giving the mere names of the ingredients, with figures to show the percentage of each.

There is a value in the use of the real thing that is peculiar and which is not approached when pictures or models are substituted, no matter how skillfully they may be made. There is always a suspicion that the model is not true to the facts, which is, of course, altogether absent when the natural object is held in one's hands, and we are able personally to verify every statement that the lecturer makes. It is this that has given nature study by modern methods its superiority over the old text-book system. One uses the object itself, the other its representative as presented in a picture or written description. The one is genuine, real, the other lacks both of these qualities, and accordingly requires a degree of credulity to fully accept.

There is in us an almost irresistible desire to touch objects that excite our interest, or, if aromatic, to test them by the sense of smell, or, if they appeal to the palate, the sense of taste. "Hands off" is a sign that is most frequently seen at fairs and exhibitions, and it takes a good deal of self-restraint at times to keep from touching some of the things we see. We instinctively reach out to aid our sight by touch.

The lecturer ought, therefore, to make use of these natural qualities whenever possible in illustrating and impressing truth, and an effective method of doing this is by placing in the hands of his audience specimens of the object that he is endeavoring to explain.

THE UTILIZATION OF FACTORIES AND FARMS.

There are two other methods of object teaching that each county institute could adopt with advantage, one of which one State has practiced. Before stating these, permit me to say that illustrative material in institute work ought not to be confined to representations such as can be used only on the platform of a lecture hall, but ought to be extended to such demonstrations and experiments as are conducted out in the stables, fields, and factories of the country. The farmers' institute is not a lyceum bounded by the four walls of an assembly hall. The institute is an organization, living out on the farms and in contact with practical demonstration work for twelve months of the year. The illustrations that it most needs are not simply the spectacular features of a subject shown in a hall, but the practical exhibition of it demonstrated out on the farms. There is, of course, an etymological difference between the terms illustration and demonstration that ought not to be confused, and yet they unite in agriculture in so far as the illustration demonstrates, or the demonstration illustrates the truth of the theory that it proves. The growing of 40 bushels of wheat upon an acre of ground by careful culture is both an illustration and a demonstration. Much of the illustrative material for use in institute work should be of this out-door character. The question is, how can this kind of material be utilized?

One State institute director has for several years with great success taken one or two representatives, chosen from each institute by its members, on a visit to farms and factories in his own and other States where are exemplified some important features of interest to farmers. These representatives are required to submit reports of their visit to their institute at its next meeting, describing what they have seen that is worthy of note, and giving in detail the methods pursued and the results secured.

This method of taking men to see the illustration and certify it to their neighbors carries conviction as no representation by a stranger, however noted, could possibly do.

UTILIZING DEMONSTRATION FARMS.

The other method of supplying and utilizing outdoor illustration is for the county institute to make up a list of subjects for experiment that need to be demonstrated in that community and call upon some of the members to undertake the work. The experiments may embrace horticulture, dairying, cattle feeding, crop growing, and other features of farm practice, to be conducted during the season and reported at the next meeting. Such experiments can be readily visited and inspected by the members of the institutes during the year and the progress of the tests be seen by all who are interested in the results.

Another method is to have several or all of the members of the institute try the same experiment and each present a separate report.

Still another is for the institute to select a set of farms suited for the several purposes of the experiments to be undertaken and agree to bear the extra expense of conducting the experiments over and above the value of their proceeds, which are to be the property of the owner of the farm. Such experiments could be under the control of a committee of the institutes and be reported from year to year as the experiments progressed.

In these ways a large amount of illustrative material would be available of a kind most interesting and instructive.

THE USE OF CHARTS.

There remain two other forms of illustration, both of which have been found to be of great value. The first is by the use of diagrams or charts.

A well-constructed diagram or chart, giving the salient points of a subject arranged to bring out some truth, is a striking form in which to display illustrative material, and in the hands of a competent man may be made most effective as a means of conveying information to an audience. Tabular matter arranged so as to show by contrast the effect of one practice with another is a common feature of this kind of work. The form of chart is frequently extended to pictures of plants and animals, often giving sections and individual organs of these plants or animals in magnified form. Such charts hold attention and keep the lecturer to his topic without the use of manuscript or notes.

LANTERN SLIDES.

The other form is by the use of photographic lantern slides projecting the pictures upon a screen.

The principal objection to the use of the lantern is that it is difficult to transport where institutes are held in districts off the railway lines. The lantern itself is inconvenient to carry and when the lime light is used the tanks for holding the gases are heavy and difficult to keep replenished during the season's campaign. There must also be a competent assistant to run the lantern during the lecture. An outfit of this character becomes a most expensive feature of an institute.

There is also the other fact that in most schoolhouses and churches where institutes are held no means are at hand for darkening the room. As a consequence the lantern can only be used during the evening session.

There is always, even under the best conditions, the danger of disturbance in a darkened hall from disorderly persons who have no interest in the subject. This has necessitated the use for the most part of spectacular pictures, and even these must be frequently changed in order to hold attention. Tabular matter of the kind commonly used in charts in a lighted room would require to be held too long upon the screen for their proper explanation, thus rendering the ill-disposed impatient, and invite disturbance. Because of these difficulties the lantern has not hitherto been used in institute work to the extent that its merits justify.

Many subjects can not be properly presented or understood without being accompanied by the objects themselves. Frequently it is impossible to have at hand the material itself or a picture of the scene that is needed in order to an understanding of the topic, and the only way remaining is to omit it altogether or else employ the lantern slide and show the objects on a screen.

The introduction of acetylene gas as a substitute for the oxyhydrogen flame has greatly simplified the question of transportation and supply of proper lighting for the display of photographic slides. The employment of acetylene for lighting is now permitted by the underwriters of all of the insurance companies, and thus the way is opened for its use in lantern lecture work, thus greatly reducing both the cost for gas and the bulk and weight of the apparatus needed for generating light over the unwieldy and heavy gas tanks necessary in former years.

OVERCOMING OBJECTIONS.

The other objections to the use of the lantern in institute work still remain, but the advantages of this method of teaching are so great that the National Department of Agriculture in its institute office is endeavoring to overcome the two chief difficulties hitherto encountered—that of maintaining order in a darkened hall during an hour's lecture and the other equally important one of interesting a general audience in subjects somewhat technical and of practical importance chiefly to farming people.

A number of experts who have each given special attention to some phase of agriculture have been engaged by the Department to prepare sets of 40 to 50 photographic illustrations of their subjects, representing each subject in its early stages of development and continuing in progressive series until the finished product has been obtained, these photographs to be exhibited by a lantern on a screen. The illustrations are accompanied by a syllabus treating of the subject in all of the phases exhibited by the photographs, to be used as a guide by the lecturer in his presentation of the subject to the audience. The syllabus contains references to the literature of the subject so that anyone desiring to pursue the study further and discover what is known upon that topic will have at hand the names of the publications bearing upon it and the places where these publications can be had, together with the price of each. An appendix, with tables for reference, is also a feature of the syllabus. These printed syllabi are to be distributed through the audience, to be retained as memoranda of the lecture for future reference.

By selecting for discussion subjects of interest and by providing for the frequent change of the illustrations, it is hoped that the difficulties that have heretofore been experienced in lantern lectures before institute meetings will be overcome, and by presenting each person with a full outline of the lecture, with interesting additional data attached in the appendix, it is believed that permanent benefit will result from the presentation of the subjects.

The lantern slides are to be loaned to institute lecturers without cost except the express, and the syllabi are to be sent out for free distribution. If upon trial any lecturer is satisfied that any set that he has used is of sufficient advantage to him in his work as to make him desire to secure a set for permanent use, such set will be furnished by the Department for the nominal cost of the preparation of the slides and the expense for transportation. The syllabi will be supplied free of cost.

THE ABUSE OF ILLUSTRATIONS.

It is perhaps unnecessary to call attention to some of the abuses of the illustration method that exist. Most of you have witnessed instances for yourselves. It is seldom that vulgar or sacrilegious stories are told in farmers' institutes, and yet instances have occurred where questionable allusions have been made. The correcting of this evil is a simple matter. First an admonition to the speaker, and later if this is unheeded, the denial of the privilege of appearing before an audience.

Perhaps the most common form of abuse in the use of illustrations is to indulge in the recital of too many funny stories. Frequently these are not needed for the illustration of the subject, but are introduced in order to raise a laugh and set the audience in a gale of merriment. A single witty lecturer has in this way been the means of destroying the serious character of an entire institute, although what he has said was altogether unobjectionable from a moral standpoint, and his audience was delighted at the enjoyment which he afforded. It was not the kind of thing or the manner of saying it that was objectionable, but its untimeliness and the superabundance of the funny.

An occasional anecdote well chosen and applicable is a great addition to almost any address, but a train of these coming in quick succession breaks up all seriousness, and the meeting loses its character as an earnest school of instruction.

The instructor who indulges in the overfunny method is likewise injured by the practice. He comes to be regarded as a funny man, and is under obligation to maintain the reputation. This requires considerable effort continued year after year until his own seriousness is affected and he degenerates into a story-teller and mimic, on a level with the end men of a minstrel show, who regard life as a huge joke to be ridiculed without reserve. An occasional kindly admonition will often keep the funny member of the institute force in reasonable restraint, and by placing him at the end of the programme, will save the institute and send the audience home highly delighted and anxious to come again.

AMUSING STORIES NOT ESSENTIAL.

In our efforts to interest an audience it is well for those who are somewhat sedate or perhaps not specially skilled in the art of story-telling to remember that it is not necessary to tell funny stories or to mimic the peculiarities of others in order to hold attention. Apt illustrations of a serious kind are just as effective in retaining attention and exciting interest as are the most amusing stories, and have the additional advantage of enabling the speaker to retain control of his audience with no danger of its breaking away into a carnival of fun.

The introduction, therefore, of appropriate illustration in farmers' institute work is an addition to its usefulness that has not received the attention of institute directors in the past to the extent that its importance deserves. It frequently not only relieves an address from the dead level of monotony into which many are apt to fall, but rightly used also makes more clear the thought which the speaker wishes to impress.

It serves both to interest and instruct, and furnishes a flash light that the lecturer may use in photographing truth upon the minds of his hearers, appearing and disappearing as the interests of the topic seem to demand.

Discussion.

Mr. Creelman commended the address, but questioned the general applicability of the use of the blackboard for illustration purposes. Both he and Mr. Dye, of New Jersey, spoke of successful use of a blackboard which could be rolled up and was thus easily portable. Mr. Dye also stated that he had found live animals, specimens of fruits, and other products, as well as diagrams, useful in certain cases.

Mr. Clinton, of Connecticut, cautioned against putting too much dependence in illustration. "Some of the poorest lectures I have heard at farmers' institutes have been most fully illustrated with lantern slides, and I fear that one trouble the lecturers may get into is the mistake of thinking that the lantern slides will carry them through, instead of depending upon the merit of the lecture itself."

Mr. Amoss, of Maryland, stated that he had tried nearly all the suggestions made by Mr. Hamilton and had found some applicable to one section of Maryland and some to another, the different sections differing very much. "I suppose that holds good with all the States. Some States can adopt one or more or all, and some will have to follow ways of their own."

THE RELATION OF THE AGRICULTURAL COLLEGE TO FARMERS' INSTITUTE WORK.

Frank H. Hall, of Illinois. The principal function of the experiment station is discovery. The principal function of the agricultural college, the high school, the district school, and the farmers' institute is dissemination.

The agricultural college looks to the experiment station and to the investigators of all ages for its facts and theories. With these as educative material it attempts to prepare students for every vocation that is closely related to successful soil culture and rural home making.

The agricultural college may and should prepare some of its students for each of the following lines of work:

(1) As teachers in the college itself.

(2) As investigators at the experiment station and elsewhere.

(3) As teachers in the high schools and in the normal schools.

(4) As managers of enterprises in which thorough technical knowledge of soils, plants, and animal husbandry is required.

(5) As speakers at institutes and as leaders in spreading the gospel of a better agriculture.

It may also prepare men for actual work on the farms, and women for household duties; but under present conditions this part of the field must be mainly occupied by the agricultural schools, the "short course" schools, the high schools, the common schools, and the farmers' institute.

The agricultural college as a purveyor of knowledge looks to the experiment station for a large part of its supplies, and for its work of dissemination it must have its hand on all the lower schools as well as upon the farmers' institute.

Educational progress is usually from the top downward. The college determines the course of study for the high schools, academies, and the normal schools. These in turn give form and content to the instruction in the common schools. The college of fifty years ago, with its classical course called "broad and general," but really narrow and specific, made Latin, Greek, and mathematics the principal studies of the academies and high schools. When science secured a place in the college course coordinate with the classics immediately science was given a place in the high schools and later, in a small way, in the grades. Now that the agricultural college has secured for itself a place in the university, coordinate with the other colleges, it must—it will—make itself felt in the high schools. It is important above measure that the elements of agricultural science should be given a place in the common school curriculum; but any attempt to force such a change without first according it a place in the high school and in the normal school will be in the main abortive. The high schools and the normal schools prepare teachers for the common schools. Teachers who are ignorant of agricultural science will not succeed in a high degree in interesting pupils in that branch of study, even could a public sentiment put this task upon them.

Under present conditions the agricultural college will not, as a rule, be called upon for speakers for the institutes. It is the experiment station men, and so-called "practical men," who are in close touch with the work of the station, that the people will come out to hear. It is the experiment station and not the agricultural college that has wrought such a marvelous change in the farmers of America toward scientific agriculture. Professor Chamberlain comments upon the change in the institutes that took place soon after the Hatch Act brought into existence the experiment stations, as follows:

"It was my privilege to compare the agricultural conventions of this State (Wisconsin) at two periods separated by a decade within which the experiment station became a potent influence. The dominant intellectual and moral attitude of the earlier period was distinctly disputatious and dogmatic. * * * In the second period the dominant attitude was that of scientific conference."

But while it is the stations that are giving new life and character to the institutes, it is the colleges that are the "head center" for the dissemination of agricultural truth.

The stations working through the institutes may arouse the people and create a sentiment in favor of agricultural education, but the colleges working through the schools must do the main part of the work of dissemination.

It may be said that the act that called the stations into existence provided for the distribution of the knowledge to be gained by means of bulletins and circulars. But this is insufficient and inadequate. Only one farmer in twenty attends the institutes. Of those who attend, only one in twenty receives the bulletins. Of those who receive the bulletins, only one in two reads them. Of those who read them, only one in two puts into practice the truth presented. One in 1,600 in vital touch with the station—a liberal estimate.

And so it happens that "dissemination does not keep pace with discovery." Or, as the Hon. John Hamilton puts it, "We have a great reservoir full of valuable scientific information to which the mains have not as yet been laid." To be sure, the agricultural colleges have laid mains to this reservoir of scientific truth, but they have not yet extended them through the lower schools to the people. This is the one great present need.

The farmers' institute, too, has done a little tapping of the reservoir, but the flow is small, and only that which is immediately helpful is sought. Great principles and underlying truths must come, if at all, through the other channel—the college and the schools.

Hence, the relation of the agricultural college to the farmers' institute is mainly indirect but important.

(1) It is closely related to the experiment station, which is the source of life to the institute. From the experiment station it receives some of its most valuable material, and it gives back to the station some of its very best product.

(2) It should be closely related to the high school and to the normal school, for these are the sources of life to the common schools. From the high school it should receive its very best students, and to the high school it should give teachers and such a course of study as will promote interest in country life and a thirst for higher agricultural education.

(3) It is related more directly to the institute because of its part in preparing the men who are sent out by the station as speakers and leaders in the discussion of agricultural topics. To be sure, the institute asks for men from the experiment stations, but the experiment stations ask for men from the agricultural colleges.

And so it happens that in a sense the college is the "head center" of all, reaching out through the experiment station to the adult farmers, and reaching out through the high, normal, and common schools to the next generation of farmers and farmers' wives.

There is yet another way in which the college relates itself to the institute. Every man that the college sends out to the farm to put in practice the facts and theories which he has learned at the college, becomes an important factor in creating sentiment that favors agricultural education, and, therefore, farmers' institutes. And in such important work, it makes little difference whether, as a student, he took the "short course" or the long course. If the college is a good one a single term will convince the student of its advantages and make him forever a friend and supporter of all that pertains to scientific soil culture. Hence, as it seems to me, those colleges that by means of "short courses" and long ones, by means of broad courses and narrow ones, by means of deep courses and shallow ones (when it is a necessary choice between that which is narrow and superficial on the one hand and nothing on the other hand), those colleges that bring the greatest number of people in touch with scientific methods are doing most to promote a sentiment that will continuously and cheerfully provide equipment for more extended agricultural education all along the line, from the kindergarten to the university.

I have spoken thus far only of what I believe should be the attitude and influence (mainly indirect) of the college upon the institute.

But what should the institute do for the college and for agricultural education in general? A transaction or a relation to be in the highest degree satisfactory must be mutually advantageous

All the institutions herein referred to exist for the general good. Their purpose is the discovery, dissemination, and practical application of truth. The institute must do its share.

(1) It must help to create a desire for better methods in agriculture and for higher agricultural education.

(2) It must help to strengthen the sentiment already exising in favor of generous support of every institution herein named.

(3) It must encourage the introduction of elementary agricultural and domestic science into all the schools. It must especially insist upon their introduction into the high and normal schools, for in no other way can such teaching become general in the common or district schools, and in no other way can the connecting link be put in place that will bring the people into close and vital touch with the agricultural college.

(4) The institute must at this stage of the work invite the young people and their teachers to its sessions. It must help to convince them that education is for use; that the higher life is the useful life; that the highest life is the most useful life; that the first purpose in education is to enable one "to earn his own living by the exercise of trained powers;" that there is no vocation in which mental training and equipment will be more advantageous than in farming; that this vocation will give ample opportunity for the exercise of all the intellectual power one possesses; that its rewards are inferior to none; that its duties are no more burdensome than those of other occupations; that the chances for success are greater by far than in most occupations, and that nothing can be more honorable than, "by the help of God, to cut a straight path to one's own living through the sunshine and the rain and the sprouting grain," and that few things are more dishonorable than the attempt, by the help of the devil, to cut a crooked path to one's own living through the fortunes of other people.

The farmer has little temptation and little need to engage in the speculative or disreputable. For him the soil is on tap. What he gets diminishes no man's fortune. By the help of God and the experiment station he is the creator of wealth. But he needs the college, too.

And the college needs him, and both need the experiment station. The vital relations of the theoretical and the practical, of the educative and the productive, are being understood as never before. The educators and all the people are beginning to believe what Doctor Baldwin, of Yale, said some time ago, that "the chief end of life is not to get an education, but to use an education;" that the purpose of all education should be increased efficiency in doing something that needs to be done.

Says James Freeman Clarke: "Theory without practice to test it, to verify it, to correct it, is idle speculation; but practice without theory to animate it is mere mechanism. In every art and in every business theory is the soul and practice is the body. All success depends on practice, but all improvement on theory. Let neither despise the other."

The agricultural college, with its coworkers in the educational field, is the soul of twentieth century agriculture. The experiment station, with its coworkers on the farms, is the body. Neither can do without the other. The institute should become one of the connecting links between them; one of the forces to keep soul and body together. The soul without a body, in the cultivation of the soil, is as useless as a body without a soul.

The institute as it exists to-day is the child of the experiment station. Let it be nourished and fostered until it shall become the parent of higher agricultural education for the masses; until all the people shall more clearly understand the relation of theory to practice, and shall more fully appreciate the measureless opportunities and the "marvelous attractions of rural and industrial life."

Discussion.

C. M. Conner, of Florida, stated that the relation of the agricultural college to the institute worker is somewhat the position of the teacher with reference to his pupils, since men are nothing more than boys grown up, and since the agricultural college teaches the workers. He thought that the agricultural college could assist the farmers' institutes by encouraging boys during their college course to prepare themselves for institute work.

ADVERTISING FARMERS' INSTITUTE MEETINGS.

Mr. Kaufman. Advertising the farmers' institute meetings is one of the most important things in connection with a successful series of farmers' institutes. At least such has been my experience in the brief period institutes have been held in North Dakota. This is especially true where the amount of funds at your disposal is limited, and you find it impossible to have what might properly be called an "advance agent" for the institutes.

At the time of taking hold of the work in North Dakota I had never attended more than one-half dozen farmers' institutes and, knowing absolutely nothing as to how they had been advertised, a system of properly advertising had to be worked out to suit our conditions. In treating this subject it is not my intention to offer many suggestions as to how an institute meeting should be advertised, but to state how this work has been carried on in North Dakota, hoping thereby to bring out the experience of others along this line.

In the first place, I prepared a blank form of application for a farmers' institute meeting. This was to be a formal application for an institute, and when signed by the local committee, they had agreed to furnish a hall, properly heated and lighted, and to assist in advertising the meeting. I usually selected one of the committee who had signed the application with whom to carry on the correspondence relative to that institute. If possible, it was some one with whom I was personally acquainted. I also urged that in the selection of a local committee the business men and farmers should both be represented, and by all means the committee should be one in whom the farmers had confidence and who had been successful as farmers and business men.

The only advertising matter furnished by the State is a large poster calling attention to the institute and the subjects to be treated during the meeting. These are sent out four weeks before the date of the meeting, and in nearly every instance I have found the committee did their work fairly well in distributing these posters. I also urged the raising of some funds for the payment of hall rent and for lighting and heating, in addition to getting out some advertising matter locally. An excellent plan has been for the local committee to have a postal card printed and sent to each farmer inviting him to be present at the institute, giving the time and place of the meeting, and urging him to come prepared to ask questions and give his experience if called upon. Some places, in addition to the postal-card invitation, have had distributed a week before the institute a small poster announcing the speakers and the subjects that were to be taken up by them. At one of the best institutes held in our State the past year the business men arranged to furnish luncheon for all the farmers and their families who would attend the institute. This was at a small town in the northwestern part of the State, where the farmhouses are few and far between, but, nevertheless, there were over 250 people attending the institute. I also endeavor to enlist the local newspaper in the institute, either through the committee or by writing the editor a personal letter, if not already acquainted with him. All but a very few are willing to give their space freely for advertising the institute, but in many instances, not having had any experience with such meetings, they don't know exactly what is the best thing to do. To many of them, if you send a list of the speakers and the subjects each is to discuss, they will publish the list without any comment whatever. To get around this difficulty last year I took it upon myself to write notices of the institutes and send them to the editors ready to be put into print. This is usually more satisfactory to them, but entails considerable labor upon the superintendent, for I can assure you it is no light task to write editorials on the farmers' institutes for a half dozen papers in the same territory and not say the same thing about each speaker. Nevertheless, I carried out the idea for the 46 institutes held last year. If it was possible to visit the different places where institutes have been scheduled, it would be advisable to have printed on the large poster the name of the hall in which the meeting would be held. Then about a week before the institute I think it would be a good plan to send to each of the country school-teachers within a radius of 10 or 12 miles a quantity of printed handbills stating where and when the institute would be held, the object of the meeting, the names of the speakers, and the subjects to be discussed. These handbills can be printed in large quantities very cheaply. A list of the teachers can be secured from the county superintendent of the schools, and every boy or girl in the country would thus be advertising the farmers' institute meeting by carrying home one of these handbills. At one of our especially well attended institutes the local committee, the chairman of which, by the way, was editor of the local paper, had printed in large quantities a small handbill or "dodger," as it is called. This dodger simply stated where the institute was to be held, the time at which the meetings would open, and invited everyone to come and bring the family. These were distributed among the business men of the town, and for a week or ten days before the institute every farmer purchasing a bill of goods found one of these little dodgers wrapped up with it on reaching home. It was very effective in making known the institute and bringing out a good attendance.

The postal-card invitation is a very good idea, and where there are plenty of funds the superintendent should have them printed and sent to the local committee for addresses and mailing. At the same time, it is an excellent idea to have the local committee get out their own invitations, as it shows they are interested and will work to make the institute a success. At one place last year I know of $140 being subscribed by the business men for the institute. So far as I can learn they adopted every scheme that I could suggest for advertising. It is needless to say they had a successful meeting.

I thoroughly believe in having the locality assist the superintendent to the extent of furnishing a hall and paying for some of the advertising. If there is not enough interest in the meeting to attempt this much assistance it is doubtful if the institute will be a success.

I have found that four-fifths of the places where institutes have been held send in applications for meetings the next year. This is sufficient evidence to me that that particular locality believes in the institute and is willing to render some assistance to make it successful.

Discussion.

Mr. Menges, of Pennsylvania, stated that in Pennsylvania the institute is usually advertised in about the way Mr. Kaufman had suggested, with probably the exception that the newspapers take quite an interest in advertising. Nevertheless the attendance is not as large as it used to be or as is desired. He thought sufficient attention was not given to advertising the lectures.

Mr. Kaufman, of North Dakota, stated that the papers in his State were quite ready to help in the institute work, but they did not know what to do or how to do it. They need assistance in advertising the meetings. The assistance of railroads in the way of reduced rates had helped greatly in the attendance at the institutes. The feeling toward the agricultural colleges and experiment stations is one of respect and confidence.

Mr. Dye, of New Jersey, thought the providing of luncheon added an attractive feature.

The competitive idea was condemned by Mr. Gregg, of Minnesota. He held that a good institute would advertise subsequent meetings.

Mr. Ellis, of Missouri, had found the competitive feature of value in Missouri when kept within limits and not allowed to overshadow the strictly educational part of the work. He thought this was also true of all entertainment features, although the tendency was for them to detract from the main object of the institute. The educational side of the competitive exhibits should be kept prominent.

"In Missouri we have no round-up institute meetings, but we have a number of State associations that hold annual meetings, and we cooperate with each of those associations. We arrange to pay from our institute fund the expenses of one representative from the agricultural club in the college to attend each of these meetings, and to read a paper on some subject. We also seek out our best graduates that go back to the farms and try to arrange for them, the first year after they graduate, to do at least one week's institute work, paying them a small salary and their expenses. We put these young men forward as the conditions indicate are best, and thus try to develop some of them into good institute workers.

"We find it very difficult to maintain any local permanent organization. Our organizations in the county are nearly all temporary, for one year only. Where we have permanent local organizations, such as dairy or horticultural associations or granges, we work through them and do not try to bring about an independent organization. But where we have nothing of that kind we have some trouble in maintaining a permanent organization.

"As has been said, the best plan to advertise an institute is to let it advertise itself. We have proven that to be true. Some advertising, however, must be done, and we find that unless we prepare the notes and editorials a majority of the editors, while anxious to use the material and to promote the institute, do not know what to use. Another plan which I have tried is to send personal letters to from 50 to 300 farmers living within a radius of a few miles of the place of meeting, and I think these personal letters have a very good effect."

Mr. Dodson, of Louisiana, spoke of the importance and difficulty of reaching those who read the papers but little and are not in touch with the progressive men of their communities.

Mr. Huston, of St. Louis, commended the competitive idea, but stated that it must be handled with tact or it may make ill-feeling. Especially should the institute lecturer avoid acting as judge in competitive contests. He thought that the matter of advertising could be accomplished with no great expense if pains are taken to properly report the meetings.

Mr. Thoburn, of Oklahoma, spoke of the mixed character of the population and varying conditions in that Territory, and expressed high appreciation of the value of advertising, considering the success in Oklahoma in the matter of attendance as proportionate to the kind and amount of advertising done.

"Our organizations are permanent; they carry over from year to year, and as the success of a local institute largely depends upon the energy and the ability and the willingness of the secretary, I get them to select the right kind of a secretary, who will take care of things and then I help him to do the advertising."

He had found that under certain conditions competitive exhibits served a useful purpose, although it might not be wise to make it a permanent feature of institute work. He thought special effort should be made to interest the boys.

COUNTY ORGANIZATION FOR INSTITUTE WORK.

Mr. Latta, of Indiana, briefly explained the conditions in Indiana and the organization of institutes in that State.

"The institute act under which we operate makes it mandatory on the institute committee to undertake an institute in each county in the State.

"Another condition that exists there is that the committee of general management are all men busily engaged in other lines. The institute is not simply a side line, but it is one of different lines these men are occupied with. The chairman of the general committee is president of the university. Another member of the committee is the director of the experiment station, and a third member is a member of the faculty of the school of agriculture and certain administrative duties grow out of that relation.

"Now, the purpose in effecting a local organization should perhaps receive consideration for a moment. There are several purposes in view. One is to fit these conditions that I have mentioned, to divide somewhat the labor, to share the responsibility, to get the people throughout the State to take some portion of the work, and to enlist as many people as possible in all portions of the State, to learn the needs of the people as fully as possible without going over the field again and again, as we have not time to do visiting in person to any great extent. To locate the meetings intelligently is another purpose—that is, meetings with reference to local conditions. Our purpose now is to hold these meetings within reach of every farmer of the State as frequently as possible. We hope to do that once in about three years, to get around again and again, so that every farmer will have a meeting within easy reach if he is disposed to attend. Another purpose is to provide some local funds with which to supplement what the State can give for the work.

"We have had a form of local organization almost from the first, but as the work increased, as the number of meetings became greater, we saw the need of some more uniform and effective form of organization than we had, and one year ago the general management proposed a plan of organization county-wide in its extent, one which should, in the roster of officers, represent every township in each of the counties of the State. This general plan, of course, organizes the people of the counties into institute organizations or associations having a definite recognized relation to the general management and having certain local duties to perform.

"These are organized with a president, a secretary—perhaps a secretary-treasurer—and a township vice-president or committeeman from each township in the county. All of these rosters of officers are reported to the general office, so that we have there on file the names of the officials connected with these local organizations and have a ready means of giving information relative to any section of the State—its suitability for a farmers' institute, the nearness of a hall, etc.

"We are now also setting out to effect a like organization of the women of the State under the term of 'home makers' associations' or 'women's auxiliaries,' and I doubt not that we shall have a number of women's auxiliaries in addition to those already existing within the coming year. In that case we should have all the way from twenty to thirty or more persons officially related to the work in their respective counties, depending on the number of counties. In my own county we have some thirty-two persons connected with the institute and the 'home makers' association.' In many counties where they have more townships there will be more. That will vary from perhaps 12 to 15 up to 20 or 30.

"I might say that early in the season a duplicate form of letter or mimeograph sheet is sent out requesting the township chairmen to call their subordinates together and give the superintendent advice as to where they would like to hold meetings and as to the subjects that they would like to have presented by the speakers at those meetings. Very early in the season, perhaps in February or March preceding the year when the work is done, the chairmen are counseled to confer, to get an expression of the people in the different townships, and secure representation in the returns sent in. These are carefully arranged, and the meetings are grouped with a view of effecting an economy as far as possible, and with a view also of assigning the workers who will treat the desired subjects.

"We are now seeking to multiply the number of meetings in the ratio of the area of the counties. The smallest counties are to have two days of institute work, the next larger county three days; then, the larger county four days, and the largest counties five days of institute work, and these local officers will make this selection after conference with each other, the purpose being to insure that all the localities shall have a fair chance for their portion of the meetings.

"When this work is done in the superintendent's office, a schedule is made up and published, and a list, containing not only the assigned speakers but others as well, is sent out. The rest of the work is left largely to these local organizations. They have already named the places of meeting. They secure halls, schoolrooms, or suitable meeting places for their meetings and do all such work, and conduct the meetings, the chairman acting as the presiding officer, as a rule.

The meetings are reported usually to the local papers, and always to the superintendent on blanks furnished for that purpose, so that he keeps in touch with the work.

"Over 50 of the 92 counties in the State effected permanent organizations on a uniform basis in the past year, and our conference recommended that the work go on, so I presume the remaining counties, or most of them, will organize during the coming year, and we shall have then perfected the local permanent institute organizations in all parts of the State.

"One of the necessities for perfecting this organization was the inequalities that were observed in the selection of places of meeting, where the institute had the privilege of voting for a place of meeting. Of course the place that had it this year, if it was a good meeting, had the right of way for the next one and the other points had no show. We definitely provide now that the officers shall constitute an executive committee and they, after conferring together, shall make selections, and of course they have time to do it deliberately and intelligently. So when meetings are located it will be in their judgment where they can be successfully held and where the people will actively serve."

Discussion.

Mr. Putnam, of Toronto, Canada, stated that the system described by the previous speaker was in large part the same as that in use in Ontario.

"I hardly know how we would start out to hold successful institute meetings in Ontario if we had not these local county permanent organizations. We have had these organizations since I first had anything to do with this work, fifteen years ago. We have somewhat extended these organizations since that time, of course perfecting them, but they are practically along the same line. We have from one to three or four organizations in each county, depending upon the size of the county and the population. Each electoral district forms a permanent organization and appoints its officers. One of the great advantages of this is that you have men in each county, in each township, who feel a personal interest in the work, and if we want any particular work done in a certain township or county we feel that the secretary of the county or the electoral district has a man in that township or county that he can put to do the work and carry it on. We consider that the secretary of the county organization is the man to whom the superintendent looks to have things carried out.

"We do practically all of our arranging for meetings through correspondence with the county secretary. Of course we have a full list of the directors in the different townships and we write to them, spurring them on; but we leave a great deal of the detail to the secretary. We find that it is better to do that; that we can have more uniformity in that way. These officers are appointed at a special meeting called for the purpose of election of officers and the naming of the places where institute meetings are to be held that year. They look over the ground thoroughly to see whether a certain township or certain portion of a township has been neglected, or if they can not get another director in a certain corner of a township who will work things up in that township. It seems to me the great need in Ontario is to have more men, or better men probably, appointed to take charge of the local work. There are a great many young men and a very great many farmers, even in Ontario where institutes have been held for eighteen years, who hardly know what an institute is yet, and the great problem before us is how we can reach more people, how we can get at the young people. As I have said, we look upon the secretary as the chief officer in the county, and we do not want to change him from year to year; we want to keep the same man at that work, a man who becomes familiar with the forms we require him to fill out. He studies the matter of advertising, and in that way is of great assistance to the superintendent. We generally find that as soon as the secretary is changed the work is apt to lag for a year or two, until the new secretary gets hold of the ropes.

"At the meeting for the selection of officers the directors select the places at which they wish meetings held during the following institute season, both where the regular metings are to be held and the supplementary meetings. We hold two series of meetings in each county. The first series we call the regular meetings. Each county is allowed two of these meetings, and the department undertakes to pay the speakers' traveling expenses and everything except the advertising for those two meetings. For the four supplementary meetings we undertake to pay the wages of the speaker, while the local institute pays the traveling expenses. Any additional meetings are paid for entirely by the local organization. Some of these local organizations hold as many as twenty meetings during the year in an electoral district.

"The way in which these local institutes are enabled to do this is this: They charge 25 cents membership fee for every person who joins the institute. They are given a Government grant of $25, and they get a grant from their county council of $25. The Government grant is given to them on condition that they get the $25 from the county.

"And another method which they have of raising money is running excursions to our agricultural college and experimental farm. A great many of the counties get special rates from the railroads and run an excursion there, and some of them make as high as $150, or $200, or $250 out of their day's excursion, and they use that money for their local work.

"I can not impress upon you too strongly the importance of having good members of the board of directors. They are useful in many ways, but especially in assisting in the local advertising.

"If a meeting which has been arranged and advertised has to be canceled on account of bad weather or sickness of the speaker or for any other cause, these local men are there and they will arrange for a meeting in two or three weeks, advertise it among themselves, and hurry it on, and probably have just as successful a meeting as otherwise would have been the case. They arrange for speakers themselves, through their own secretary, and carry on this meeting independent of the department at Toronto, although they are required to report and to superintend all meetings which have been held.

"They also hold seed fairs, which are a very good feature.

"As regards judging competitions, I wish to emphasize the fact that you must be very careful in arranging for them or you are apt to create local jealousies. It is much better to get all the stock which you are going to use at a judging competition from one person and have a competent person to point out the good and the bad points of the different cattle in the exhibition, and, if possible, get a number of volunteers from the audience to enter the competition as judges. After they have expressed their judgment they are interested in it and are anxious to see what the man in charge of the class will point out in the way of any mistakes that may have been made.

"I think also that a feature in connection with this work which should prove very beneficial is the holding of monthly meetings during the winter months. I would not advise it during the summer months, but during the winter I think we can well furnish work for the various townships.

"I have in mind that I shall collect information from each locality as to its particular needs. Then when I ask an institute man to go to a certain locality to speak I will furnish him with the information which I have as to the particular needs of that locality. He can then have his address in readiness to be suited to the people he is going to address. I think that is a very important feature of the work.

"In some places in Ontario we have a canning factory here and a few miles from that we have a pork-packing establishment, and in the next county it may be that they give most of their attention to the raising of horses. We have to cater to the different localities, and we must be prepared to do that if we are going to educate the people in the true sense of the word."

In reply to a question, Mr. Putnam stated that he thought that the superintendent should spend much time in the field to learn local conditions and should arrange, if possible, to hear every speaker at least once.

George W. Dean, of Illinois, spoke briefly of the growth of farmers' institutes in that State.

WOMEN'S INSTITUTES.

Mrs. S. Noble King, of Illinois. In our State (Illinois) the question of holding separate women's institutes has never been raised. From the first the work of the women has been affiliated with that of the men; but I will tell you as briefly as I can what we have accomplished and what we purpose to do in the future.

A little less than seven years ago a few women who were interested in scientific methods of housekeeping decided that the farmers' wives ought to have subjects presented at the county institutes along lines of work peculiarly their own, and steps were taken to secure an organization in the different counties, to be known as "domestic science associations" and to work with their husbands and brothers in the county institutes.

The purpose of these organizations was twofold—first, to learn and practice better methods in our homes; second, to help to secure the introduction of domestic science into the public schools of our State, country schools as well as city and town schools. The presidents of the county institutes were asked for the names of three or four progressive women, living near together, who would be likely to take up a work of this kind and who would inspire other women to do the same.

Through these efforts 20 counties were organized the first year. Since that time the growth has been steady and gradual, and to-day 90 of our 102 counties are doing active work. It was soon found that a meeting held but once a year could be of very little benefit, and the women decided to form study clubs which should meet once a month—some of them bimonthly.

As these meetings were usually held at the county seat many women who would like to do so were unable to attend, and they formed auxiliary clubs in neighborhoods, some counties having five or six. The first organization in a county is responsible for the programme of one session at the county institute, and every club is expected to send delegates to the annual meeting, which is held in connection with the State farmers' institute.

These women are studying sanitation, hygiene, nutritive value and cost of food, bacteriology, care and diet of the growing child, diet for the aged and invalid, care of the sick in our homes, and many other topics which are of interest to the intelligent housekeeper.

The first obstacle met with was lack of literature on the subjects which were to be studied. This was overcome by the generosity of the State farmers' institute, who gave us funds for a library, which is in care of our State secretary, and which is free, except postage on the books, to all the women in the State who are members of our organization. This library, which consists of 120 volumes, is made up wholly of books relating to some phase of home life. A club may take three or five books at one time and keep them three months. An individual member of a club may take one and keep it two weeks.

While people are talking a good deal about domestic science and thousands of women are studying it, there are still many who think it is limited to the mechanical work of cooking and sewing. If household science meant that only, it would occupy but a small part of the field which legitimately belongs to it. In studying the subject of cookery the object is not to learn to make fancy desserts or new salads, but rather the chemistry of cooking and the application of the proper degree of heat to various food substances. We try to have our practice in cooking illustrate a principle, just as an experiment in the chemical laboratory does, thus eliminating "luck," which has so long been responsible for underdone bread, overdone steak, and poor coffee.

In housework more than in any other occupation conservatism bars out new discoveries, and it is said that less progress has been made in this industry in the last two hundred years than in any other, but from present indications that can not truthfully be said twenty-five years hence.

Tradition has been carried from one generation to another, and it is still believed by some that women have an intuitive knowledge of housekeeping and the care of children, and this, too, in the face of many dismal failures and the appalling mortality among children. Dr. Felix Oswald says that "In America alone the little sparks of 100,000 lives are annually smothered out by the ignorance of their mothers."

When our grandmothers were girls they were taught all the household arts with which their mothers were familiar. Beginning with the raw material, they made cloth, which they afterwards fashioned into garments; they spun yarn, which they knit into mittens and wove into bedspreads—those same bedspreads which are now so highly prized by one who has fallen heir to this sample of her grandmother's handiwork. They were taught to preserve meats for summer use, and fruit and vegetables for winter use, and even to dip or mold the candles upon which they depended for light.

And we need not arrogate to ourselves all the knowledge of scientific cooking. Many of our mothers cooked as scientifically as do the teachers of to-day, but they learned it by long and careful experiments. They learned when quick cooking would give the best results and when slow cooking was necessary. They knew the conditions necessary to make good bread, and they were adepts in the art of seasoning. In these and many other ways they were taught to take responsibility, which made them strong, capable women.

With the change in social and economic conditions the industries that were formerly carried on in the home have been gradually absorbed by factories until it is not uncommon to find housekeepers depending largely upon the manufacturer for food that can be served with only a minimum of labor and with little reference to its nutritive value or relative cost.

We need to ask ourselves the question why so few girls are in the home helping their mothers, while an army can be mustered for service in store, office, or factory. Probably there would be many answers, but it seems to me the one lying nearest the truth would be found in the low valuation set upon housework by the women of the present day. We are fond of saying that the home is the bulwark of the nation, but the work necessary to the maintenance of the home has, some way, fallen into disrepute. The pendulum has swung to the extreme, and any measure that will help to start it in the other direction should be welcomed by all right thinking men and women.

Students of sociology believe that the study and practice of domestic science would give to domestic employment the dignity which it deserves and would help to solve the problem of better living at less cost. It would give to the mistress of the home a knowledge of foods in the widest sense. She would be able to select such as would best serve the purpose of the growing child, the laboring man or woman, the aged, and the invalid. She would see that the muscle and bone building material were supplied in proper proportion to the energy producers.

There are mothers who are studying the subject of balanced rations for their families as the farmers do for their stock, realizing that every child has a right to the best possible physical and mental development.

It is no longer a question whether the character of the food eaten affects the mental and moral status of the individual.

The mistress of a home should be able not only to select food intelligently, but she should be able to cook and serve it in such a manner as to render it palatable and attractive.

Cooking is a fine art—just as much of an art as is music or drawing—and she who is master of it is deserving of as much credit as she who excels in picture or song.

We need to keep in mind the ideal which Ruskin so beautifully set before us when he said "Cooking means the knowledge of Medea and of Circe and of Calypso and of Helen and of Rebecca and of the Queen of Sheba; it means the knowledge of all herbs and fruits and balms and spices; and of all that is sweet and healing in fields and groves and savory in meats; it means carefulness and inventiveness and watchfulness and willingness and readiness of appliance. It means the economy of your great-grandmother and the science of modern chemists; it means much tasting and no wasting; it means English thoroughness and a French art and Arabian hospitality. Needlework, too, is an art, and she who knows how to use her needle deftly and how to fashion garments becomingly is just as truly an artist as is the painter who drapes the figures on his canvas."

But again I repeat that cooking and sewing are only phases of domestic science.

Every woman who is mistress of a home needs to know the sanitary conditions of that home without the intervention of the board of health. She needs to know something about bacteria—those tiny plants that play such an important part in her work.

She needs to know that some are friends and some are foes, and she should know how to cultivate the one and how to destroy the other. Every housewife should understand something of chemistry and of the laws that govern chemical changes and combinations. She needs to know something of biology, that she may understand the processes of life and growth. She will learn that sunlight is the great germ destroyer, and that dark and ill-ventilated rooms invite disease germs.

It is said that the prosperity of a nation depends upon the moral and physical condition of its people, and their moral and physical condition depend largely upon the food they eat and the houses they live in.

The habits of industry and the sense of responsibility gained by a training in domestic affairs is of no small value in forming the girl's character, in establishing in her mind the difference between being a partner in the world's work and being a parasite, enjoying always the fruit of others' labor.

On no account would we be understood as advocating industrial training to the exclusion of other studies; but it seems to have been proven that this work can be taught in the schools without loss to other branches of study.

Let us educate our girls on broad lines, in literature, in science, in art, and in music. All these will help them to be a greater power in the home, but at the same time let them have instruction in practical home affairs and the manual ability to meet the common industrial wants of the average home.

But, more than all else, if the art and science of housekeeping be taught in the schools, girls will learn to regard housework not as drudgery to be escaped from, but as work which lays under tribute many sciences and which is more conducive to contentment and happiness in the home than all other arts combined.

DISCUSSION.

Miss BLANCHE MADDOCK, of Ontario. I would like to speak more particularly of our work in Ontario. Three years ago, at the international meeting in Buffalo, the work of the women's institute was in its infancy, and many doubts were expressed in regard to its future. Those doubts, however, are being removed. I notice a difference in this national association meeting. Three years ago there was comparatively little interest taken in the women's department. A year ago, in Toronto, a few of the States, as they reported, mentioned the women's work; but, so far as I remember, even the Illinois institute did not think it worth while or sufficiently important to mention the Illinois women's work. I notice a great change here. A large majority of the different State reports speak of the women's work and the good that it is doing.

Three years ago we had 1,000 members in Ontario. We have to-day about 7,000 members. We have about 250 different organizations; that is, we have 58 district institutes, with a number of branches in each district—from 1 to 7 or 8.

There are many present familiar with the working of the women's institute system. But there are a number here who have not attended one of these international meetings before, and I will go into it briefly. The women's institute is under the farmers' institute and is conducted on the same plan. It is called the women's institute in order that it may be recognized as a department of the farmers' institute work. I have heard of the Illinois Association of Domestic Science, but did not associate it with the great farmers' institute movement. It is under the same superintendent, as I understand. Our ex-superintendent, Mr. Creelman, has really made the success of the women's institute so far. He has gone to the trouble and taken the time to aid materially in its success. Our new superintendent, Mr. Putnam, is introducing new work that I believe we are going to have a great deal of success with in the future. There is a separate grant, however, aside from the farmers' institute grant. For the last two years there has been a provincial grant of $2,000 for carrying on the women's work. This is used for a great many different purposes.

Part of this money was used for a series of summer meetings for women. This last year, through May and June, we had about 225 women's institute meetings. Each meeting was attended and addressed by two delegates, two women sent out by the department. One usually demonstrated while the other would take up some other subject.

Then, again, there is a grant given to each district institute of $10 from this fund. In addition to this, there is a $10 grant from each farmers' institute, and very often a county council grant of $25.

In that way we have money enough to carry on the work. This money is used for literature, subscribing for magazines, passing these magazines around, or bonusing one or more papers so that members get their papers at reduced prices.

Every electoral district is entitled to an institute and this grant. When an institute is organized it may be found that there are women living four or five miles away who are interested, and, if they wish, they are allowed to organize a branch, holding meetings at the different homes. They have a local fee of 25 cents a year. This is for advertising or for rent of a hall.

The round-up at Guelph is a great feature of our work. It comes at the time of the winter fair and the experimental union and the reunion of the students of the college. We have a week of it. For the last three years we have had a deputation or a delegate from each institute in the Province sent to the round-up. They come with reports. We aim to have speakers not only from Canada, but from different parts of the United States.

But what are the women's institutes doing? Are they here to stay? Is the life of the farmer's wife happier and more social, are they better housekeepers and cooks than before this organization was formed? What are the practical results?

Four years ago, when attending a farmers' institute meeting for the purpose of organizing a women's institute meeting, I found in many instances the women had to be introduced to each other. I have heard this remark over and over again: "I know your husband and your sons, because they come to see my husband and sons," and then, in a tone of apology, "You know we women haven't time to get acquainted." Then, in other sections, I have found that certain women would not join because members were not in their class or set. In other sections women in a certain church or denomination seemed to clique together; one denomination seemed to be oblivious of the existence of any other denomination. Four years later, visiting in different parts of the Province, I find a marked change and improvement. I have found that women of all circles and denominations are drawn together, that they are one in discussing anything that will benefit the home or make the home work easier or pleasanter, introducing new ideas, and making the home life happier and brighter. That the home life is brighter is easily proven. Women, earnest, thoughtful women, worried and tired by their duties at home, after attending a meeting of the women's institute, go home soothed in thought and mind; they go home with the idea of putting in practice some of the sugggestions which they have heard at the institute meeting; they go home with new ideas and the reflex influence of sunshine and gladness is felt upon every member of the home.

But are they better cooks and housekeepers? By better cooks I do not mean whether they are able to put a greater variety and a greater quantity on the tables. Rather the reverse. In fact, one object of our institute is to do away with the tables we sometimes see, and rather than have two or three kinds of meat, pies galore, and cakes which vie with each other in fancy coloring and design, we may find a made-over dish or a relish, and well-made bread and butter.

Four years ago, when introducing the principles of nutrition, trying to teach the foods that are suitable for different seasons of the year and for different members of the family, we had to go very slowly and carefully. At first simply the rudiments of the subject were discussed. But now I find that by the discussion entered into this subject is almost as familiar to the members of the institutes as to the Department. This is due to the literature that has been sent out. The Department sends literature, and some of the grant money is expended in literature; and in some cases we have a separate library with books relating to this subject; or where there is a library already established in a village or town, certain books relating to the subject have been placed in those libraries. The members are allowed to draw these out and they prepare papers on various subjects along that line.

In that way our members are becoming conversant with subjects that two or three years ago they considered altogether too technical. Our women's institutes are not only taking up this subject of food, but many other subjects relating to the home which are quite as important. Domestic science does not mean cooking, and cooking alone. I think we have had a wrong idea of that to a certain extent. There are other subjects almost, if not quite, as important. There is the subject of ventilation, the need of pure air, the need of sunshine and health, that is quite as important as any other. All these subjects are taken up and discussed. We aim in our institute work to develop the all-round woman, with a love for the beautiful, and to strengthen the spiritual and moral.

The cultivation of a love for the beautiful has been one of our specialties for the last year or two. We have encouraged the members of our institute to have a women's institute exhibit at our fall fairs. I noticed last year a tendency on the part of the members to note the little things around them in a way they did not do formerly, and to find beauty in the things around them that had previously been entirely overlooked by women living on the farm. As a result, we have more wild-flower bouquets, and we noticed a difference in other respects in the country home. The other day I was asked to note the vines on a tumbled-down veranda. It was a beautiful place, almost like fairyland, yet it was an old-fashioned house. The gentleman who called my attention to the matter said, "Every one of these vines has been found within half a mile of this house." I notice this tendency is increasing year by year, and we try to develop the love for the beautiful in our institute work.

In order to help mental development we have in some of our progressive institutes a roll call. As each member's name is called, instead of simply answering "present" she gives a quotation from an author, or, if she prefers, sometimes a recipe of some sort—for instance, it may be a recipe for removing stains. In connection with this method of giving a quotation or a recipe it was found that one woman in one institute did not seem to know anything about what was going on in the outside world. She, like a great many others, had been living her own little life, and had heard little about the outside world. In that institute they decided to have each woman respond to her name by giving a quotation from some public man. This has resulted in wider reading and a broadening of views in the family.

We believe we are solving a problem that has caused some of the greater minds of the United States and Canada many an anxious thought, viz, how to bring the women of town and country together, to interest and broaden the minds of the women living a secluded country life by meeting with women from town, and to give the women from town an idea of the peaceful life of the country; and at the same time interesting each in the pleasures and difficulties of the other. As in many sections of our Province the meetings are held alternately in town and country, this is possible of accomplishment. The women's institute is a purely home organization and of course is of interest to women of town and country.

Again, I believe we are becoming more cosmopolitan in our ideas as we read and think and come together.

Are the institutes to succeed? I believe they are. In my mind their future success is assured, because their object is the uplifting, the developing of the home, the mainspring of society, and the pulse of the nation.

Mrs. J. W. Bates, of Indiana. Women's institutes teach efficiency, accuracy, and contentment. They teach the farmers' wives to see nature and home surroundings in a new form. Washing, ironing, cooking, mending, and the care of children are not held as duty alone, but with the knowledge of how and why these tasks are performed the once irksome duties become a pleasure.

Woman's work is placed beside man's work in every department where her efforts and ability place her in competition. Her influence is recognized for refinement and betterment wherever her work is found. Her limitation is not the home or field alone, for her influence is already felt in several States in farmers' institutes and women's institutes. The home maker's brain should be educated as well as her brawn. For does not the physical condition of the child from infancy to manhood depend upon her?

The skilled home maker, with her magical tools of flour, butter, meats, and vegetables, stands equally with the skilled mechanic. We hear so much about balanced food rations for our live stock. The dairyman knows just what to feed for the greatest milk supply, the beef man knows the elements of feed to produce the greatest amount of fat and muscle in the shortest time and for the least expense. Charts line our institute halls giving the minutest detail for all grades of animals, but the farmer's wife trusts in Providence and fries her beefsteak without the assistance of chart or teacher.

There is no practical school where the farmers' wives can attend and be taught the elementary principles of home making, and if there were, their time is consumed with household duties and rearing of children. They can no longer shift responsibility, they are helpmates, and, in a sense, bread winners.

Women's institutes become a postgraduate course. Timid women, with years of wise experience, become enthused and give the benefit of these years to younger ones. Association of ideas brightens the intellects. Personal contact brings out new thoughts. Women's institutes teach dignity and poise of manner. They give a parliamentary and intellectual drill to all who take a part in the discussion. Our women and our homes hold a high rank, and our agricultural interests are advancing rapidly, but the interests of these homes must be represented at our farmers' institutes to maintain their dignity.

Special institutes for women are held in 15 States. Does this mean that only 15 States recognize the value of women in the home and agriculture? Our home conditions must keep pace with the new methods employed upon the farm. And to improve these conditions we must have a new ideal to strive for. An ideal home should be the ambition of every home maker, but ideality should be tempered with reality, so that the personality of the home maker is not lost.

Domestic science covers the entire field of the woman's work, but as that term is so diversified several avenues of work can be weeded out. Any work that comes to the home maker and is done thoroughly and scientifically comes under this heading. Domestic science is household education. It elevates and broadens the sphere in which the home maker is placed and reduces the mistaken idea that housework is a drudgery. It also obliterates the stigma of the American home, the misused and sadly abused term "servant girl."

Women's institutes afford an opportunity to glean helpful instruction of a nature suited to her peculiar individuality. An illustrated talk on household conveniences will shorten her steps and lighten her work, also teach her what to do with the least exertion and what can be left undone. An illustrated anatomical chart and a good lecture will cause the mothers of girls to give their health more consideration and attention.

In all, women's institutes teach the ear to hear, the eye to see, and the soul to reach out for higher attainments in the daily life. And wherever we find women actively and earnestly employed in seeking the true conditions of their home life, we find them more efficient to master the problems of finance, and through the medium of women's institutes they are more able to meet every demand in the home.

Mrs. H. M. Dunlop, of Illinois, explained the work of the school of domestic science in the woman's building on the State fair grounds at Springfield.

"Every county in the State that has a domestic science society of any kind has the privilege of sending one girl to this school. The building has a large dormitory and a dining room and kitchen. The girls are selected, and all the expense that attaches to their coming to this school for two weeks (one week before and one week during the fair) is their railroad fare and the expense of their food while there. The instruction is free. The girls are divided into classes, or sections, or groups of four. The work is changed daily. They perform all the labor in connection with the school. One girl one day is supposed to do the dining-room work, attend to the setting of the table and the clearing off of the food and dishes. The work in connection with the dining room is under a competent instructor. Another group of girls the same day attends to the cooking, under a competent instructor. We have a large demonstration table in the center of our kitchen where 16 girls can cook at one time. Another group of girls may be doing the dormitory work for that day and another group the dish washing. We think this is exceedingly practical. All the work must be done daily and it is done under instructors who understand the business. So you see they must learn much in that two weeks' course of instruction there. There are two public lectures daily during the fair.

"We lay special stress upon the food ration of a family and the importance of simple and wholesome foods. I think we are just beginning to realize what it means to feed this body of ours as we should in a rational way. We know what it means to feed our stock properly, but we do not know, or have not known, what it means to the child.

"We first thought we would only have girls, but then we found so many married women clamoring to come in that we have taken that barrier away and the married women have the privilege. At the last school we had 6 of them in addition to over 40 girls. The schools have done a wonderful amount of good. These girls are going back into their county institutes, and oftentimes they are asked to go to other farmers' institutes. They tell something of what they learn and you can see how readily the information will be disseminated in that way."

Mr. A. B. Hostetter, of Illinois. I think it is due to our State board of agriculture to have it said that the State board of agriculture pays all the expenses of the teachers and everything pertaining to that domestic science school.

Mr. Putnam called attention to a handbook relating to women's institutes prepared by Mr. Creelman, and made a brief statement regarding the McDonald Institute at Guelph:

"This institute is a part of the Ontario Agricultural College. Nearly $200,000 have been spent in buildings and equipment. There are in attendance 150 young ladies. Some of them are taking a three months' course, some are taking a one year's course, and some of them are taking a two years' course. This, it is believed, will greatly strengthen the women's institute movement."

Dr. Mary S. Whetstone, of Minnesota, suggested that it is worth while to encourage the women's institutes, because it will bring more men to the institutes. She also thought that the bringing of city and country women into contact would result in mutual helpfulness.

"The women need every influence and effort for the uplifting of the home. If you want to elevate the home you must educate the women; you must let them get a glimpse into the breadth of life. There is very much to be said in favor of the women's institutes, and I certainly hope every superintendent and representative here will go home and do all in his power to establish women's institutes in the several States."

Mrs. Laws, of Minnesota, urged the importance of trying to impress upon the minds of young people the attractive features of farm life as compared with city life.

"A great many of them now look to the city for the fascination and charm of life. They look upon their homes as places of drudgery and are anxious to get away to the city. I found that they had been brought up to despise housework and the work that relates to the homes. As I have seen these girls and their homes, I realize that it is important to make them feel that they don't need to come to the city or away from their homes to find work and noble work. Their homes can be made fascinating. I think it is worth our while."

THE RELATION OF THE EXPERIMENT STATION TO FARMERS' INSTITUTE WORK.

L. A. Clinton, Storrs, Conn. The greatest agencies which are making for the advancement of agricultural education at the present time are the agricultural press, the farmers' institutes, the agricultural colleges, and the agricultural experiment stations of our country. These are not necessarily placed in their order of relative importance, but without doubt the greatest agency in popular agricultural education is the press. The number of readers of the agricultural papers each week and month is unquestionably greater than the number reached by any other means.

Farmers' institutes had their origin in this country about 1870. While agricultural meetings had been held previous to this time, and even as early as the beginning of the nineteenth century instruction was being given by means of lectures, yet no organized effort was made to hold farmers' institutes until about the date above mentioned. Iowa and Massachusetts were among the first to organize a campaign of agricultural education through farmers' institute methods. In Michigan as early as 1861, in the law organizing the State agricultural college, an authorization was given for the disseminating of agricultural education by means of university extension methods. The agricultural college was authorized to institute a winter course of lectures for others than the students of the institution, under certain rules and regulations. The State agricultural college movement began with the organization of the Michigan Agricultural College under act of the legislature of 1861. Under this act was organized the first State agricultural college in the United States. It will thus be seen that the farmers' institute movement and the organization of agricultural colleges took place at about the same time. The Morrill Act, under which there has been organized an agricultural college in each State, was passed by Congress in 1862. The real foundation for the widespread farmers' institute movement and for the organization of agricultural colleges under Federal aid lay in the fact that a need was felt for the practice of better methods of agriculture. The instructors in the early days in farmers' institutes and in agricultural colleges found their work quite different from that of the instructors of to-day. It was then that the professor of agriculture was expected to teach all of the branches in the college which related to agriculture, soils, farm crops, stock feeding and breeding, and the farmers' institute lecturer was expected to be a specialist in all that related to farming.

After the agricultural college movement was well under way and colleges were organized under the land-grant act, the most noticeable difficulty was in providing instructors who had definite information with reference to the subjects they were expected to teach. To be sure, their knowledge was a practical kind, and it had largely been obtained through actual management of the soil itself and through handling the various crops and animals found on the farm. While the knowledge which they possessed was the most important kind, yet they were compelled to draw largely upon their own limited experience for their facts, and it soon became evident that the greatest drawback in agricultural education was the lack of definite knowledge with reference to the subjects to be taught. Those who were most intimately associated with the agricultural instruction being given at that time saw most clearly the need for carefully planned and definite experiments which would lead to a broader knowledge of agricultural affairs. This was true because the early agriculturist was usually a practical farmer or chemist who had little knowledge of practical farm affairs, either from his own experience or the experience of others.

The agricultural instruction received by the students in our agricultural colleges and at farmers' institutes even at as late a date as 1890 was quite different from the instruction which is being given at the present time, and the change in agricultural teaching all along the line has been wrought more through the knowledge gained by the agricultural experiment stations than from any other reason. So strong was the demand for definite information relating to agricultural affairs, for experiments which would prove or disprove what was being taught, that the result was the organization of agricultural experiment stations.

For some years before the passage of what is known as the Hatch Act, under which the Federal experiment stations were organized, high-grade experiment work was being conducted in connection with several of the agricultural colleges, and especially were Connecticut, New York, Michigan, and Massachusetts pioneers in the line of agricultural experiment work.

The successful farmers' institute lecturer of the present day is possessed with a mass of data and facts which has been largely secured as the result of experiment station work. So generally accepted now are many of the facts relating to agriculture which a few years ago were unheard of that we even forget that it is only within recent years that these facts have been discovered and the principles underlying them demonstrated. No farmers' institute lecturer at the present time would attempt to discourse upon the subject of soils without a knowledge of the work done by King of Wisconsin, Hilgard of California, and Whitney of Washington. No expert upon the subject of animal feeding would attempt to give a lecture at a farmers' institute without a knowledge of the work done by Armsby, Henry, and Jordan, and these men mentioned have all been pioneers and leaders in experiment station work. Along other lines of agricultural knowledge than those mentioned is the mark of the experiment station equally evident. Agricultural bacteriology was a science practically unknown until within recent years, and even dairy bacteriology, which the farmers' institute lecturer will discuss learnedly, was almost unmentioned ten and fifteen years ago. The best experiment station work has been done by the men who saw the most apparent need for such work, by men who realized most fully the shortcomings of agricultural knowledge and the deficiency in agricultural instruction. Much of the best work has been done by men who have, to a considerable extent, been occupied by other matters.

The experiment stations and farmers' institutes were both organized for work in part along parallel lines. But while the farmers' institute is clearly an educational proposition, the experiment station is not only for the dissemination of information, but it is first of all for the securing of information at first hand. The duties of the experiment stations were stated in the act of March 7, 1887, commonly known as the Hatch Act, and they were said to be "to aid in acquiring and distributing among the people of the United States useful and valuable information on subjects connected with agriculture, and to promote scientific investigation, and to experiment respecting the principles and application of agricultural science." It is thus evident that the experiment stations were organized for the specific purpose of acquiring and disseminating agricultural information. Without doubt some of the experiment stations have laid too much stress upon the dissemination idea, and have at times become university extension departments of some college or university, and have neglected somewhat the investigational work for which they were organized. This charge can not be made against the experiment stations to any extent at the present time. Owing to the wide dissemination of agricultural information through the farmers' institute and through the agricultural press it is unnecessary at the present time that the experiment station should attempt to reach every farmer in the State. Their means are too limited; and rather than divide the funds and cripple the work of investigation it is far wiser to hold very strictly to the lines of investigation, publishing the results in form which will be available for the farmers' institute lecturers and the press. There is a limit to the number of bulletins which can be issued by the experiment stations, and this limit is reached long before the people of the State who need information have been supplied. If the Federal funds are supplemented by State funds, the popular bulletin may be a wise form for disseminating information. But where Federal funds are used for paying the printing bills we question whether the popular bulletin is a wise move. The institute lecturer and the press will give the information a popular form if it is worthy.

The experiment station may be of value to the farmers' institute workers, not only through experiments which have for their object the determining of new truths, but by those which are illustrative in their nature. Certain facts are well known in relation to agriculture, but these facts are often not adopted and put into actual practice because their value in certain localities has not been demonstrated.

The effect of tillage is well known to the experiment station worker who has investigated it, but it will be continually necessary to demonstrate so simple a thing as the effects of tillage upon plant growth, even though no additional light is brought to the subject.

Cooperative experiments between the stations and farmers throughout the State are popular in some sections. These experiments result in the dissemination of information by the stations. They are largely educational in their nature and seldom result in securing any data which is of definite scientific value. Their practical value as educators can not be questioned. Where the Federal funds are supplemented by State funds, so that cooperative work can be looked upon rather in the nature of university extension work, having for its object the dissemination of information rather than for pure investigation, this work may become valuable, indeed, as a supplement to the agricultural education of the State. Where the funds of the station are limited to the Federal appropriation, it seems unwise to spend any considerable amount of this in conducting cooperative experiments with farmers throughout the State. Greater educational results will be secured by carefully conducted experiments under the personal supervision of the station force, securing results of practical and scientific value. These results can then be published in bulletins and be given wide circulation by the press or by the farmers' institute lecturer who is not engaged in station work, but who uses as a basis for his lectures information which has been secured by the experiment station. So far as possible, without interfering with the experiments, the station workers should actively engage in farmers' institute instruction. This is true not only because information given at first hand can be made especially interesting; it is true not only because the farmers may be benefited by the instruction which they would receive, but it is especially true because of the benefit the station workers will receive by contact with the farmers throughout the State, who are meeting every day with practical problems which have not yet been solved by any experiment station. The most successful experiment station worker is the one who comes in closest touch with the men who are most specifically interested in the results of his work, namely, the agricultural classes.

A man may be a most careful investigator and a thoroughly scientific investigator and yet be an utter failure as a farmers' institute lecturer. This is especially unfortunate for the investigator as well as for the audience. The farmers will get the benefits of the results of his work through some other lecturer who is able to take the facts which have been revealed and present them to an audience in an interesting manner. The station worker is nevertheless an active factor in the farmers' institute work, even though he himself does not possess the faculty of presenting facts to the farmer. Some of our best experiment station men are capable of putting an audience to sleep inside of ten minutes. Some other man, however, like an Agee or a Rice or a Gould, will take these same facts and present them to an audience and it will declare that the lecture was most interesting. The closer the relations maintained between the farmers' institute lecturer and the experiment station in every State the better will be the quality of the farmers' institute work done and the more practical will be the station work. The time has passed when general statements of information and funny stories can be palmed off on an audience of farmers. They are demanding facts; they are demanding specific information, and for this type of information the experiment stations must be drawn upon.

The plan which has been adopted by New York State might well be adopted by other States. Every year before the beginning of institute work the entire lecture force is rounded up for a time at the State Experiment Station, at Geneva, and for a time at the Cornell Experiment Station. The men who are to go out into the State and sow broadcast agricultural information are required to spend several days in actual work and consultation with the experiment station men and discuss with them the latest information with reference to the topics to be discussed.

A recent report from the Office of Experiment Stations shows that 323 experiment station workers engage in farmers' institute work. This large number shows that there is an active cooperation between the men who are devoting their time largely to work of investigation and the men who devote at least a part of their time to giving agricultural instruction throughout the State. The experiment station can be of greatest value to farmers' institute work as this relation becomes closer. While it is not always a matter of convenience or pleasure, and not always of profit, for the station worker to leave his home surroundings and his work, which is congenial, and go up and down the State, putting up at so-called hotels, where even a fair night's rest can not be secured, yet a certain amount of this work may be of great benefit. It is important to get the farmers' point of view, to enter somewhat into their life, and the station worker who goes out for the first time to address some wide-awake audience is likely to be called upon to answer questions which he has never thought of before, and enough problems for investigation may be suggested to him to keep him busy for the rest of his natural life.

The experiment station is best doing the work for which it was organized when it is doing work which will advance the agricultural interests of the community. This can only be done when a definite knowledge is had of the needs of the community. This knowledge can best be secured by actual contact between the investigator and the farmer.

While illustrated lectures and lantern slides have their place, yet they are too often made the end rather than a means to the end. The farmer wants facts clearly stated, and it is not necessary to turn a farmers' institute into a school of farce. The experiment station worker needs to have not only facts, but he needs to have these facts systematized, arranged, and classified. He needs to have them not only written down on a slip of paper, but he must be so familiar with his subject that he can proceed without a moment's hesitation.

Could every station man take a part in the farmers' institute work of his State every winter he would be a better station worker for it. Could every farmers' institute lecturer spend one or two weeks at his State experiment station before beginning his winter's campaign, at the close he would be the better prepared for his work. Closer relations would be established between the scientific worker and the class to be benefited by his work. As a result the benefits would be mutual. The work of investigation would be given a more practical turn, and the farmers' institutes would become more truly agricultural schools. Thus would both institute and station be more fully meeting the requirements for which they were organized.

DISCUSSION.

Mr. C. A. ZAVITZ, of Ontario. I think, perhaps, the keynote of the paper to which we have just listened might be embodied in two ideas: First, cooperation, and second, the proper sympathy and understanding between the farmers' institute worker and the needs of the people.

I will dwell briefly upon those two points. I think we have all been thoroughly impressed during our meetings of the last two days with the importance of cooperation. Here we have met together; we have been talking about the work of the agricultural colleges; we have been talking about the work of the experiment stations; we have been talking about the work of the farmers' institutes, and the greater sympathy and cooperation there is between those different lines of work, those different institutions, the greater will be the results of any one of them.

I think that one of the most important things in connection with our institute work is that those who take up the work will come closely in touch with the people with whom they are dealing. In one of the papers that has been read it is mentioned that we should be thoroughly conversant with the work of Armsby and Henry and such men. That is true. It was also mentioned that we should be in touch with the needs of the people. That is just as important, I think, as the first.

Now, how can we get in close touch with the people? There are different phases that might be taken up, many of which have been referred to already; but there is one line of work which has been touched on here this afternoon, on which there has not been very much said in the meetings of the past two days, and therefore I will dwell upon that phase for a little while. It was just touched upon by the speaker. I refer to the cooperation between the station and the farmers. Some eighteen years ago, when I became connected with our agricultural college and experiment station work, I felt that there was a need of bringing the results of the experiment station in closer touch with the farmers than had been done in the past. Our experiment station had been running then for about ten years. We were obtaining some valuable information, which was being brought out in bulletin form and disseminated among the people; but you know that a great many of the farmers can not take the bulletins and reports and glean out of them the real cream of the work and make practical application of that work as well as if they were better trained along certain lines. We started about eighteen years ago in a very simple way to see what we could do in establishing a system of cooperative work among the farmers. The first year we sent out letters, and we got 12 ex-students of the college to conduct experimental work on their own farms, at their own homes, in connection with the work at the college. We sent them instructions and sent them seeds and encouraged them in their work, and they carried on experiments; and from those 12 experimenters we received eight good reports. The next year there were 60; the next year there were 93; and the work increased in interest and in value among the ex-students and also among the farmers generally throughout the Province who came in touch with the cooperative work. In 1889 there were about 225 and the next year about 400 experimenters. The work has gradually increased from year to year until this year we have 4,050 farmers upon their own farms carrying on experiments in connection with the station work.

I remember that we had been engaged in the work about six years when I wrote to a large number of the agricultural experiment station people and many of them thought that there was not much value in cooperative work, that the farmers could not carry on scientific experiments, the results of which would be of general interest. That is true to a certain extent; but, still, what are our agricultural colleges for, and what are our experiment stations for? They are to help the farmers, and anything we can do, whether through our colleges or through the experiment stations, that will assist the farmers, I think, is the line of work we should take up.

We have been following this work for some eighteen years in Ontario, and not only have we studied the results of the experiments, but have also studied the men themselves, as well as the crops with which they have been carrying on the experiments. And we have now a considerable number of men who have been carrying on experiments for five, six, seven, ten, and even a dozen years, on their own farms, and they are thoroughly trained in this work; and I believe I am safe in saying that there has been no feature of the work that is particularly the station work and the college work, more in touch with the farmers. We now have experiments in agriculture, in horticulture, in live stock, in poultry raising, in forestry, and also in other lines. In agriculture alone we now have over 4,000 experimenters. During this last year we had thirty-five distinct experiments, covering nearly the whole field of agriculture. Do we realize the great importance of the farm crops of our two great countries?

I do not know the exact average market value of the farm crops of the United States, but it must be an immense amount, for in the Province of Ontario the market value of the farm crops now amounts to about $150,000,000 a year. You see how important it is that the experiment station should be brought in close touch with the farm. We carefully study the work of our experiment station and then arrange 35 experiments in agriculture, and have 4,000 farmers cooperate with us in making a practical application of this work on their own farms. We find it brings them in touch with the most important results of the experiment station work in an admirable way. Besides being interested in the cooperative work, they also become interested in the other work of the experiment station. What is the result? Not from the cooperative work alone, but from the farmers' institute and the agricultural college, from the experiment station and from the cooperative work all combined, we find that there is an entirely different feeling in connection with the college work and the station work now from what there was a few years ago. Perhaps this is one of the reasons why there will be some 35,000 farmers within the month of June who will get up in the early mornings and drive 5 or 6 miles and take the train and come 50 or 100 or 150 miles to the college and go out to the experiment plats, for an hour and a half in the burning sun, as they do each year. They are intensely interested, as shown by the questions they ask, and we have a splendid time together. They take up the questions that they have to deal with every day. They take up those practical questions that they are interested in in their everyday work on the farm. It may be such questions as to whether it is better to put in the corn in rows or in hills; whether it is better to cultivate roots on the level or in drills; whether it is better to sow grains of certain selections or grains of other selections, etc. They become interested in plant-breeding work along those lines which the farmers can take up to advantage for themselves, and so one experiment after another is discussed. When the people, numbering 500 and 600 in a group, ask questions dealing with those things that they meet with in everyday work on the farm, they are in real earnest and are after information that will help them.

I have sometimes heard it mentioned that there are some lines of experiment station work that are not of as high a class as other lines of station work. For instance, the testing of varieties and the testing of methods of cultivation, and that sort of thing. To me, the line of work that is going to do the most good for the people we are working for is the highest class of work we can take up. Scientific problems are of great value, but while going into them we must not forget the men who are working on the farms day after day from morning till night and are meeting questions every hour of the day regarding which they want information, and let us, as institute workers, come in contact with those people and go out with them on the farms ourselves. I have been connected with institute work, perhaps, more than any one else at our college, simply because I wanted to do it. I wanted to do it for two reasons. One was that I wanted to keep in touch with the people themselves and to know their needs, and the other was to bring the results of our experiment work before the people.

Therefore, I have been in touch with the work for the last thirteen years at the various institute meetings. This, in connection with the excursions to the experiment station where they come in numbers varying from 300 to 3,000 a day throughout the entire month of June, gives an opportunity to come in contact with these people and understand their conditions, and also gives them an opportunity to understand our conditions. You will see that there is cooperation running all through beween the college and the station and between the station and the farmers on the little experiment farms all over Ontario. Just think of it—4,000 experimenters. What does it mean? Four thousand little stations all sending out their influence, each one being a center of information. Two years ago I asked how many people saw just one of the 35 cooperative experiments, and I learned that fully 25,000 people saw this one experiment on one farm or another. That was only one experiment. And we have 35 experiments altogether. You see it gets the people in touch with the idea of experimenting and investigating for themselves. It was mentioned in the paper that cooperative work among farmers is largely educational work, but not of much scientific value. Well, supposing it is. Is the experiment station for the people or are the people in existence to build up the station? I believe the stations are established for the benefit of the people, and whatever we can do to help the people to become better farmers is what we should do.

This cooperative work opens up new lines of thought. I have been asked the question, "Well, a man or a woman will write to the college because he or she may want to get something for nothing, may want to get some seeds, simply because they think they can get something for nothing. What do you think of that?" Suppose they do. They are the men and women we want to get hold of. What does it mean? It means that if we can take that man or that woman that asks for that seed because it can be obtained for nothing and we can keep those people in our minds right through and finally get them to think and work along better lines than formerly, we have done one of the greatest works which it is possible to do for those people.

We try to get the farmers interested in this experiment work, and as soon as we get them to experimenting they do not look upon it as the college experiment, but as their own experiment. You put a farmer upon his honor and he feels he is somebody. It has been stated that cooperative experimental work by the farmers is valueless unless some official is appointed to visit the experimenters and take full charge of the work. I say no; that we do not want that. We give them carefully prepared directions, and we want those people to feel that it is their experiment in every case. Suppose the result is not of great scientific value. At least you get that man started to observe. That man then takes his neighbor to his plats, and he says, "I have some varieties of oats that I am experimenting with," and they begin to talk it over. Perhaps the next year another variety of oats will come in the neighborhood, and this same man will say, "Well, I didn't take much interest when I started to experiment last year; I thought it would be difficult to carry it out. But it is not so very difficult after all, and I am going to get some of this new variety of oats. I will put in a plat of this new variety, and also a plat of the variety which gave the best results last year, and another plat of the variety I have been growing for the past ten years." Suppose that this man happens to drop into a farmers' institute meeting and the subject of oats is being discussed. He will be on his feet giving his experience in growing oats before he is aware of it, and will perhaps be in a position to give better information on oats than any other man in the room. This answers as a simple illustration of the beginning of results of one of the very simplest experiments.

I believe this to be one of the most practicable lines of work which the stations can take up. I know there is a good deal said against it; but this cooperative work has been a hobby of mine. Eighteen years ago I had the greatest faith in this work, which I have been at ever since, and the work has been increasing steadily during all this time, and my faith in it is stronger every year. It has the right elements of education in it; it has the right elements of training in it; and you will see—mark my words—that the cooperative work will become a very important factor in connection with the agriculture of North America. You get the farmers interested along these new lines of work, and then they are going to be friendly toward advanced agriculture and have a greater influence in the world. As mentioned a while ago, we are simply on the fringe of this great movement. I do not know very much yet, but I know a great deal more than I did know eighteen years ago, and we want to work together in this, and if we do I am sure it will have a very great influence. We know the influence it has had in Ontario already. Our crops have increased about 60 per cent during the last seven years. What has done it? The cooperative experimental work, the experiment station, and the farmers' institutes all working together have certainly exerted a very great influence. The fact that there is so much cooperation in this meeting is why I have enjoyed it so thoroughly. I think the future should be very bright.

HOW TO TRAIN THE FARMERS' INSTITUTE WORKER.

F. E. Dawley, Fayetteville, N. Y. Twenty years ago, when the institute work was new, almost any successful, practical farmer who had ability to express his thoughts and who had convictions made an acceptable institute worker, and to-day in many sections and before many audiences a man of this type furnishes the best of help; but he must be something more than a practical man who has achieved success. His success must have come from agricultural practice carried out along orthodox lines, and his opinions must be backed by scientific information.

We have come to a time in the history of the farmers' institute movement when the best work will be done by men and women especially equipped for this work, capable of imparting information, who have in their own work achieved success, and who are able to show the evidences of having applied the results of the best agricultural thought and research in their practical everyday farm work. The principal reason why this type of lecturers is demanded is that the farmers of New York State are a reading, thinking people, and the majority of them are much better posted than were the leading men a generation ago. The means for spreading information have increased wonderfully, and during the past few years people have been better able to purchase books and papers, the inclination to experiment has gained ground rapidly, and everywhere are men who are trying the newer things in agriculture. They are reading everything they can obtain along the line of their specialties, and when a speaker who knows his subject addresses them he finds them receptive and anxious to obtain information. They are continually reading and thinking, and each will bring a more cultured brain and more accurate knowledge of the principles which underlie their specialties than the year before. The farmers' institute lecturer who undertakes to be received graciously must not only be abreast of the times, but he must be in advance of them.

I do not mean to say that a knowledge of agriculture will make any man a successful farmers' institute worker. One may have studied all branches of agricultural chemistry, soil physics, and be thoroughly posted in many other lines of scientific thought and research and still not be acceptable. The farmers are anxious to meet men who are studying in nature's great school, and those who have worked out their problems in the soil with the tree, shrub, or plant are the ones who are best equipped to impart knowledge.

In a corps of workers it is of the utmost importance that the work of the speakers be uniform and that the facts cited by each speaker coincide with all the rest. In order to make the work of our men more uniform and keep them thoroughly up to date, some years ago we inaugurated the system of normal institutes, taking the workers to the State experiment station for three days and to the State college of agriculture for three days, where the instructors and lecturers at these institutions were asked to review the work of the past year in their various lines of scientific research. The institute workers were asked to take notes and, in case anything came up with which they did not thoroughly agree, they were expected to discuss the subject in open meeting, thus arriving at an understanding on disputed points and at the same time getting the latest accepted thought of the scientific men. Our men are not only benefited from this line of work, but we secure a representative from the office of the commissioner of agriculture, who thoroughly posts us on the agricultural law of the State and on the workings of his department. The national laws relating to pure food, oleomargarine, and kindred subjects are discussed, and our men leave these gatherings with a large fund of information that they did not have before.

DISCUSSION.

Mr. CREELMAN. The first thought that occurs to me is, Where are we going to get the men to train? Then, what are we going to do toward educating him for our particular work? We want the man who can tell what he has done on his farm, laboring under the same conditions as his neighbors. We have two sources from which to get that sort of man. First, the agricultural college graduates or undergraduates on their own farms; second, men who have been successful in their own line of business whether they can talk or not. In Ontario we develop men from those two sources largely. There are drawbacks in each case, as many of us know. We have to go into the backwoods with a man who is pretty well down to backwoods conditions, but he must, above all things, have been successful. The superintendent of the institute must make sure he is honest and straightforward in his methods and then get him to go and tell about what he has done.

The other man is the agricultural college graduate, who is generally gotten by going to the president of the college and securing lists of promising men and visiting those men on their farms to see what kind of men they are. We select those who prove good and develop them.

In the training of institute workers somebody must be at work at it in every State and province twelve months of the year. The time has come when enough should be appropriated to enable the institute director to devote his whole time to the work. Three thousand dollars can certainly be appropriated to pay the salary of a first-class man to work twelve months. I believe our good results in Ontario have been due to the fact that we have worked steadily at the job all the year round.

As I have said, the first step is to catch your man; the second is to stay with him during the rest of the year and prepare him for the work. In fitting him for the work there are two things we do immediately. First, we insist on his going to visit the agricultural college and experiment station, even if we have to pay the expenses, and staying with the professor of agriculture and the director of the experiment station and studying their work until he is filled with the idea that these institutions are for the people. A great many have not got that idea. It is important to overcome any prejudice against the college which may exist. The institute man is required to visit the institution once a year or to go there during the time of the winter fair in December and to look over the work. The second thing we do is to get all the workers together and have a short period of special training, particularly in animal husbandry.

We recommend the pick of these men to the State board of agriculture and have them appointed expert judges for the fall fairs in the Province of Ontario. They thus get information, so that when they are called upon suddenly as demonstrators at farmers' institutes they know what they are talking about, whether it relates to cattle or what not.

This year Mr. Putnam has arranged a line of instruction for his institute workers at the fall fairs. He gives the men work for a longer time, and in this way gets better men.

It is a mistake to send out men not well experienced, especially young men. I find that they come back in one of two moods: Either they have made up their minds that they are the best institute workers that have ever been out, or, having run up against some pretty strong opposition and not getting as good a welcome as they expected, they are discouraged and do not want to go out again.

It is not necessary to tell you managers that, but I have found it is well to pick out a good, strong, experienced man and put a young fellow with him, following that up by sending the best literature you can. When I find something new I send immediately and get a copy for our workers. I do not wait until the edition has run out. I write a personal letter to each worker, calling particular attention to certain features of the publication applicable to his case. I find it accomplishes a great deal more to write a personal letter in this way, calling attention to certain paragraphs, than simply to have literature sent. I also send every one of my men, and pay for it out of the State grant, at least one good agricultural newspaper every week. I select some paper that uses a good deal of farmers' institute information. Then every week or every two weeks the superintendent can put in the paper a column or two or three, or a page, not necessarily over his signature, of good institute stuff, which, with the understanding of the editor, he will publish.

If too much is not attempted and the workers are only held responsible for the subjects they are expected to teach, you soon have a corps of trained institute workers. We now have sixty workers in the Province of Ontario, whereas ten years ago there were none. The first and second years we had the professors of the college, the third year we had one professor and two farmers, and now the professors have all dropped out and we use them in an advisory capacity only. We now depend upon the professor to be a final judge with reference to varieties and fertilizers and such things as he has made a specialty of during the year.

With all of this I believe the farmers' institute work of the Province of Ontario can take credit, in conjunction with Mr. Zavitz and the agricultural college, for having done what he has mentioned. We have doubled the output of the Ontario farms in ten years without any appreciable increase in population or acreage.

H. A. Huston, of St. Louis. One thing that specially interested me in Mr. Clinton's remarks was the statement that no man would think of discussing the question of soils without he was familiar with the work of the foremost soil investigators. This should be the case generally, but unfortunately there are a great many who discuss soils who know little about the subject. It is along that line that I believe you need to exercise great care, because the soil is the fundamental thing in agriculture. Large numbers of men are specializing in fruit, in live stock, and in all sorts of lines, and trying to inform themselves thoroughly on those subjects, but the men who undertake to make themselves really masters of the soil question are exceedingly few and far between. The most of our institute workers are what might be called local farm specialists, men who have done good, successful work in certain lines, but oftentimes they have been successful because of local conditions which do not apply generally. They do not always realize this fact, however, and they go into other regions and give advice which the conditions do not warrant.

Whatever may be the merits or demerits of the case, I believe the subject requires attention. If you can teach some of the specialists along lines which are remote from soil study to keep quiet about the question of soils, or persuade them to refer inquiries to sources where they can get reliable information, I think you will have accomplished a good deal in the training of institute workers.

NEW PROBLEMS AND METHODS IN INSTITUTE WORK.

PROBLEMS IN THE EAST.

Mr. Franklin Dye, of New Jersey. The first problem I name is the institute itself. Who will prophesy as to its permanency and its usefulness? The former will be determined by the latter. Will it outlive its mission? The answer to this question will depend somewhat upon our conception of the work of the institute as an educator in its relations to other agricultural educational forces.

The teaching methods of the institute are, in some respects, original and peculiar to it. They combine the lecture of the practical teacher, whether from the laboratory or the field, with the questions of the field workers and the answers of the teachers thereto, making a method of instruction quite unique. In most other schools of instruction the pupils have had little if any practical experience in the application of the theories and principles they are studying; this comes after graduation.

In the institute the pupils never graduate; the lessons are few and far between; new problems confront them year after year, and the institute provides an opportunity, usually, for their solution. The institute occupies a position similar to that of the care-taker of farm stock. Our stockman must select, prepare, and bring to each animal the food best adapted to accomplish the purpose for which it is allowed to exist. So the institute manager and speaker must find the best and most appropriate information available, year by year, and carry it to the workers on the farms in their several neighborhoods. They can not go to the agricultural college. They can not, many of them, assemble in a far-distant convention. Their work keeps them close at home, and their means, usually,. will not allow the expenditure for long absence and travel. This is the province of the institute, and it is peculiar to it.

The sources of information, however, are not confined to the institute; these are everywhere. The most prominent and in many respects the most valuable is that afforded by our agricultural colleges and experiment stations. The wise institute worker, realizing this, will endeavor to draw into his budget of information all of this that can be utilized in the teachings of the institute. He can not afford to ignore it. The man of the farm who continues his fling at "book farming" is fast becoming an extinct species, and may usually be ignored if he can not be converted.

To further solve the problem of the institute itself it is highly important that the farmer and his family should be convinced that the institute is for them. Its mission is to help them in every way possible. It is their school. How best to interest the farmers in this work, so that they will consider it as their organization and take an active part in making their institute the best in the county, is somewhat of a problem by itself. The farmers' institute must interest and help the farmer. When it fails to do this its mission will end. Women's institutes are closely identified with the foregoing. What can be done to introduce and popularize this branch of institute work? Its field is large, its work among the most important.

Another problem, in some States at least, is where and how to secure the money for meeting the expenses connected with the work. When the agricultural population is in the majority in any State, this may not be so difficult a problem. Votes have a mighty persuasive force in matters of legislation. This word "legislation" implies that we expect the money to be provided by the State; but there are those in other callings who can not understand why the State should thus help agriculture and not help other trades as well. I will not debate that point here.

In some States, and I believe in some of the provinces of Canada, the farmer pays an annual membership fee, a small sum in addition to that provided by the State, and thus he becomes a member of the institute, entitled to all its benefits. This plan has its advantages.

In some of the Eastern States of the United States the agricultural population is but a small per cent of the total. To obtain State funds for the assistance of so small a proportion of the population may not be so easy as it is where the agriculturist can make and unmake legislators. But we will not hunt for trouble. Each field has conditions peculiar to itself, and the workers will no doubt find a way for the perpetuity of an institution that has so many possibilities of usefulness before it.

Another problem for institute workers in the East is to popularize the business and the work of agriculture. Both these have within quite recent years become so unpopular that farmers' sons are seeking other callings, and laboring men will not take up the work of the farm except as a last resort, and sometimes not even then. The cause or causes of this reaction from this essential industry should be found, if possible, and the remedy applied.

The hope of larger and quicker pecuniary returns than the farm as usually managed affords tempts the farmer's son to seek both in some other business, and a working-day of fewer hours than the farmer's day, a definite time to begin and quit the day's work, with absolute freedom from work nights and Sundays and prompt payment every week are inducements that tempt laboring men away from the farm, and these facts should not be ignored by the farmer when deploring the scarcity of farm help.

If our institute methods, as now carried on, and the instruction now given, will help the farmers to reap greater profits than they have hitherto received, will encourage them to make the farm home and the farm life more attractive and the work less onerous, we are pursuing the right course. But if we are failing to reach these results, even to a limited degree, there is a failure to recognize opportunity and fulfill a responsible obligation.

Another problem peculiar to the position of institute manager, old and yet always new, is the selection of properly qualified institute conductors and competent speakers. Each position requires a fitness peculiar to it.

The institute platform has special attractions for the would-be public speaker. The novice, with a few glittering generalities, is everywhere offering his services as institute speaker. But there are other novices who have excellent ideas and a measure of knowledge who are diffident. These need encouraging in order that they may become thoroughly competent for this responsible work.

I have used the term "selection." Fortunately there are enough professional conductors and speakers available at this period of institute growth. But how and by what methods shall these important positions be filled? Arrangements, organization, attendance may each be all that could be desired, but a misfit here will bring disaster. A round peg in a square hole or a square peg in a round hole will not answer. The conductor and the speaker should each size up to the requirements as nearly as may be possible. How select? Well, that is your problem, Mr. Institute Manager. If you can have a civil-service examination without being uncivil to the candidate, have it. But there are other ways of deciding.

With all our teaching along other lines, what should we do and what can we do in the way of implanting, increasing, and fixing a high moral standard among our farmers? A standard of character and action founded on the teachings of God's eternal truth and a keen sense of their responsibilities as heads of family and citizens of a great country. Fellow institute workers, let us encourage them to higher ideals and nobler ambitions, both in their profession and in their influence as citizens. With the farmers right and united the country will be safe.

NEW METHODS.

One ever new method will be needful, and that is to so arrange the topics from year to year that the institute as an educative organization shall not go so slow that the farmers will precede its teachings in actual practice, and, on the other hand, not press on to new questions or the deeper scientific ones before the farmers are ready to intelligently and fairly apprehend what is presented, else they will become discouraged. In a word, keep just ahead, on the agricultural skirmish line, but not so far as to lose sight of the advance column. Hold to the farmer with one hand and reach out to the lines of progress as they are revealed from year to year by science, study, and practice with the other, and thus bring the two together in the institute.

New methods will be required in the presentation of the subjects to be considered each succeeding year. Some of the subjects are old. They have always belonged to agriculture—they are a part of it. For example, the soil and its products; what the soil is and how it produces its annual harvests were questions but little studied and but partially understood prior to the work of the chemist. True, there were some, here and there one, who thought upon these matters. So Tull, of Berkshire, England, 1701–1731, thought on the question, "How plants grow." By what process are they built up and what and from whence came the materials?

His conclusion was that, in some way, they took up the finer particles of soil and incorporated them into their body, fiber, and fruit. From this erroneous hypothesis he deduced the proposition that, the finer the soil was pulverized, the more rapidly and perfectly would his crops develop. His theory of fining the soil did, no doubt, show some favorable results in his case, but not in the way he supposed. What he guessed at is now made plain, and it should be the business of the institute managers to introduce the study of the old subjects and so present them that the farmers shall be encouraged to think upon them from a correct foundation, in order that greater intelligence may obtain in field practice and larger profits be secured.

So, too, concerning all the staple crops in their different requirements in the matter of plant food, methods of cultivation, etc. Domestic or farm stock has been with us from the beginning, but its almost marvelous development in beauty, size, and productiveness is comparatively recent. These questions, with many others, must claim the attention of the agriculturist so long as men live by the products of the ground. And the institute worker must present them in some form each year. The problem for the conductor is how and under what subdivisions and form of topic should they be considered. Again, staple crops in one locality may be introduced in a neighborhood where they have not previously been grown. They become new crops there, and the institute speaker may treat them there exhaustively, beginning with the first principles.

Agricultural education in the common school is an important question. What can the institute conductor do to help on this change? What method can be adopted whereby he may enlist the approval, and, if possible, the cooperation of the makers of our teachers, the authorities in our State normal, model, and other training schools, at least to make a beginning, though small at first, in directing the young minds to the wonders of nature all around them and the beauty and value of such knowledge.

Nature study is coming to the front. Wise methods will be required to so direct it that practical and permanent benefits shall accrue to agriculture and agricultural workers.

Most all the work of our farmers is connected with nature study in some form and most of our institute topics have to do with such subjects. A part of our work may be to get back to the starting point, anticipating and preceding the agricultural college by having the first principles of agriculture taken up in the home, the rural school, and the farmers' institute.

Can we introduce the beginners' institute for farmers' boys and girls, with speakers—common-sense teachers—to explain and illustrate the first things, the foundation principles, correctly, thus forming a helpful base for full development? If so, what method will serve our purpose best?

New problems and methods—they are not confined to the work of farmers' institutes. Problems new and old are everywhere; they are associated with all human activities. Their solution requires new methods. The man who would succeed in his undertakings must make his work his study. A general supervision, coupled with close attention to detail, is necessary. And this applies to the institute worker as well.

Life itself is a problem. Each new life committed to parental care is to them a problem. What will be its tendencies, where its place? How shall they direct its choices and educate its mental activities so as to make a grand and useful career?

Again, to the developing mind of the observant child; what a problem of mysteries and wonders is this new world of marvelous activities to it. Ah! my fellow-workers, even we who are older have not solved all of life's problems. To-morrow may bring new complications and present problems hard to solve. And what of that far-distant, mystical soul future, encircled by the term "immortality." For the solution of all life's problems, let us use the light we have, and ever press forward assured that success will crown the efforts of the faithful workers.

Discussion.

Mr. W. L. Amoss, of College Park, Md., called attention to the success of the practice followed in Maryland of sending out, at the expense of the institutes, representatives of the local institutes to visit and report on representative farms in different parts of the country. "In selecting such men, of course, there is some danger. I ask that a committee of five be named to select a man and report at another session."

PROBLEMS IN THE WEST.

M. F. Greeley, of South Dakota. The selecting of speakers for the work is, it seems to me, the paramount issue in the institute work, especially in our northwestern country. The problem is to get men competent to go on the platform and tell what they have done and how they did it in a sympathetic, earnest way that will appeal to the farmer. If I could say one word about the selection of the speakers it is this: If possible, have them come to the platform from their own farms and barnyards and have them talk on problems they have solved. The farmers are not suspicious of that class of men. The selection of conductors of farmers' institutes is another problem in this northwestern country. In the West we need men with broad common sense who have been intimately associated with farmers and have heard them discuss the unpaid mortgage and the bad crops and that sort of thing. Such a man can take hold of an institute and get right down close to the farmers and help them in their everyday life. From such a meeting every man will go home better able to handle the problems that confront him.

In conducting these meetings it increases the interest to bring in live questions that are particularly local in their application.

Above everything else we believe in the West in short talks. We feel that we must have vigorous talks that will send the people back to their homes and farms discussing what they have heard.

Discussion.

J. B. Thoburn, of Oklahoma, spoke of the importance of interesting the boys by means of competitive exhibits, etc.

PROBLEMS IN THE CENTRAL STATES AND PROVINCES.

Mr. A. B. Hostetter, of Illinois. In the Central States we find the largest number of well-improved farms and the highest priced land. Here is the center of the pure-bred live-stock industry; here is the center of the dairy industry;

here we find the best soil and most favorable conditions for growing corn to be found anywhere in the world.

The new problems which will continue to arise in this section, and which will become more complicated as the years go by, will always have relation to live-stock breeding and feeding, dairy products, corn growing, and the maintenance of soil fertility, the foundation upon which all prosperity rests in this central division.

Our agricultural colleges and experiment stations are thoroughly equipped, are sustained by liberal State appropriations, and in charge of the ablest scientists and instructors that the country affords. Our stations are constantly making discoveries of new truths, establishing principles, and demonstrating new methods, all of which are of vital importance to the continued growth of the great industries above mentioned.

The all-important problem, therefore, is the dissemination and application to farm practice of these discoveries and teachings of the experiment stations. The farmers' institute should be made a more efficient agency in the dissemination of this scientific knowledge.

We have found in Illinois that the experiment station bulletins secure better results when used in connection with material demonstrations and the doing of things. The Illinois boys' corn-growing contest, a detailed account of which has been published in Mr. Hamilton's report, is an example of the benefit of extending the institute work into the field of practical demonstration; through this effort, 5,521 boys received not only a package of pure-bred seed corn, but they received copies of a score card and instructions for its use; their attention was directed to the experiment station and its work. Twenty-nine agricultural papers called the attention of its readers to this contest, and most of them in subsequent issues published articles on corn growing, getting their data from experiment station bulletins. One paper secured a series of lessons from an agricultural college professor on corn growing and sent copies of papers containing same to the 5,000 boys. Three strictly educational school journals called attention to this corn contest, and approved the idea of teaching agriculture in the schools. Fifty county superintendents of schools issued circulars to the teachers on the subject, asking them to cooperate with their boys in the experiment. During the coming institute season, when the boys come to the meeting with their corn exhibits, many of the schools will attend in a body. Professors from the college of agriculture will be present to give instruction.

In these ways the discoveries of science can be disseminated and put into practice. We are now receiving letters daily from the boys narrating the causes of their failures to grow corn worth exhibiting at the institute. Here is an opportunity for further distribution of scientific instruction under conditions where it will receive attention. To take advantage of this opportunity there must be clerical help; the lessons of the experiment station bulletin must be put in shape for primary instruction, and postage will be required to send it.

If the farmers' institute superintendent could be granted the franking privilege on institute matter, the States could supply the literature and in this way the dissemination of scientific methods greatly extended.

Without doubt, the best instructors we have in our institute work are the scientific specialists, who know things which the farmer ought to know and who can tell them in language the farmer can understand, and the practical men who can do things the farmer would like to do and who can show him how to do them.

To bring together the farmer who needs help and the man who can help him is a problem for the institute to solve. To accomplish this desired end the institute needs organizers, promoters—men of ability and tact, who can go into a community and devote their time and talent in learning the conditions that prevail in that community by which some farmers succeed and others fail, so that he can direct and lead the farmer who needs help to the institute meeting, where he can come in contact with the party who can help him.

There is a tendency on the part of many institute instructors to overestimate the capacity of a farmers' institute audience to receive and assimilate. They will gorge their hearers with good things until the danger is that none of it can be digested. If the instruction can not be illustrated by material things to secure the attention of the eye as well as the ear, then a syllabus of the address or oral instruction should be distributed, to be taken home for future study and reference. This syllabus should be brief; should explain scientific and unusual terms, and direct attention to bulletins and books for further information.

DISCUSSION.

C. H. McCORMICK, of Ohio. There is too much repetition and there is a good deal of filler in many of our agricultural articles and addresses. We want to eliminate anything in the way of filler, and in its place we want to have practical everyday thoughts from practical men as to the actual work on the farm.

PROBLEMS IN THE SOUTH.

J. C. HARDY, of Mississippi. The new problems in the South, I suppose, are the new problems in the West and the North.

Institute work, in my judgment, is the strongest power that has ever been organized for the reaching of all the people for the benefit of better civilization. We have come to realize that the farmers' institute movement's main function is to take the work of the experiment station and incorporate it in practice. Our effort should be to make the people take principles and vitalize them in practice.

Education which does not give power is a false education. The great secret of the rapid growth of the agricultural and mechanical colleges in the last few years is that the people have realized that men that come out from them have knowledge that can be incorporated in something concrete. The purpose of the farmers' institute movement is to incorporate knowledge in the practice of agriculture. The work of the farmers' institute must be in vital touch with the needs and conditions of the people. We do not want cut-and-dried methods, but methods should be changed in every institution to meet the needs as they are found there.

DISCUSSION.

W. R. DODSON, of Louisiana. Truly a new problem of great significance has arisen in the South to confront the directors of public education in agriculture. The solution of the now greatest question before the southern people concerns not only those engaged in agriculture, but every man and every industry that is affected by the cotton crop of the world. These diversified interests ramify into other branches of agriculture, manufacture, commerce, and finance, till it becomes not only a national but an international question. The great money crop of the South is cotton. In many States it is almost the only farm crop of great value. Eleven States produced a crop in 1903 which sold for more than $600,000,000, the largest amount ever paid to any country for the crop from one plant for one year. A new insect pest has appeared which destroys the cotton to an extent that threatens to modify the industrial and sociological conditions of several millions of people. The Mexican boll weevil is now distributed over a large portion of Texas, the largest cotton-producing State in the United States, and is invading the western borders of Louisiana, leaving in its wake desolation and often despair.

When Sherman made his long and memorable march to the sea, he left no soldiers behind to menace and annoy; new crops sprang up to feed the people, new herds soon populated the fields and meadows, new homes were built from the products of the forests, and prosperity and happiness followed soon in the path of peace. But when this great army comes on its mission of destruction, it comes, so far as everything now indicates, to take permanent possession of the land. This ever-multiplying army is rapidly pushing its conquest eastward, and there seems to be no hope of placing a barrier before it that is insurmountable. It is only a matter of a few years till the entire cotton-producing area will be infested.

It is a question of vital importance to know what we are going to do when the boll weevil is with us all over the South.

Those who have studied the question most tell us that we must change our system of agriculture, that an intensified and modified system of cultivation and fertilization must be practiced, that the cotton acreage must be diminished and a system of rotation and diversification adopted, to aid in combating the effect of this pest. That we must raise more of what is consumed on the farm and make the cotton crop a surplus crop—that is, what we can raise in spite of the boll weevil.

But this is not a proposition easy of accomplishment. These great changes must be brought about in a few years with people who are already advanced in age, as well as with the young farmers. Those who have had experience in trying to teach new methods will appreciate how difficult this is, and the difficulties become magnified in proportion to the ignorance of the man you have to deal with. A large proportion of the cotton crop is produced by the negro, and at present he seems inseparably wedded to this crop. There are many stories of distress and poverty among the negroes and poor whites in the boll-weevil section of Texas, and in many instances they have been saved from actual starvation by the generosity of the more fortunate sections. And yet, these people show very little disposition to try to produce on the farms crops needed to meet their daily wants. Thousands of people have moved out to other States where there are no boll weevils, and are continuing the cultivation of cotton, but the time will soon come when they will not be able to do this and must turn and face the enemy, and stand to their guns.

What will be the effect on the agriculture of the country when we have adopted what is suggested by the wise ones, supposing that the suggested solution is the only one to be found and that it can be carried out? Suppose the tenant farmer begins to raise his own meat and meal and other food stuff. The landowner who has depended largely upon his mercantile dealings with the tenant for making his profits that sustain him and protect his rentals must look to other sources of revenue; the packing houses in St. Louis, Kansas City, Chicago, and other packing centers must seek another outlet for a large portion of their output. The mills of the grain sections will lose an important field of revenue. The farmers of the stock-raising and grain-producing sections must throw their products on a more restricted market and suffer a depression of prices.

Suppose the cotton producer should begin to raise his own mules and horses, how long would it be before we would hear a wail coming from Kentucky and Missouri? When we teach him to raise his own vegetables and live at home, the thousands of carloads of canned goods that are annually consumed in the South, put up in the eastern and northern States, must find another market or go unsold. When he raises his own feed stuffs the upper Mississippi Valley and the West will feel the depressing effect in the markets for hay, corn, and oats, which are so largely consumed by the cotton planter.

Will it be the best thing for the country at large for the cotton farmer to become a diversified producer? This becomes a very important question to the northern and western farmer. Take the census of the United States and tabulate the names of 11 States producing the largest tonnage of hay, and you find 9 of the 11 are southern States, and you farther find that the first 5 standing highest in the list are all southern States. With her long seasons for pasture and the possibility of growing alfalfa over a large portion of her territory, the mild winters, and other conditions favorable to production of green feed stuffs at small cost, with the proper training and the stimulant backed by necessity should it come to a struggle of survival, the South could surmount the difficulties at present in the way and drive the North and the West out of business in dairy and live-stock production. But I do not believe it will ever come to that. I believe the cotton States will always produce cotton, boll weevil or no boll weevil. We have never struck an obstacle yet that permanently barred our advancement and progress, and I don't believe we ever will. The negro is with us to stay. He may locally migrate, but he will never leave the South. How the question will be solved I don't know, but I believe a solution will come, and it will need consecrated thought and concentrated effort.

The negro can not be reached through the press, but he can be to some extent by example, as he is an imitator. This is probably the only method of great importance that we can adopt. Some negroes attend nearly all of our institutes, but instruction to them must be line upon line, and we hope to be able to keep our heads above water till rescue comes in some form or another, and the negro, the mule, and the cotton crop may remain as characteristics of Dixie Land.

How we are to adjust our agriculture to the boll weevil is yet to be solved, and we need and have a claim on the sympathy and assistance of almost every section of this great country, because, as I have said before, its influence radiates to almost every State in the Union and to other nations. The National Department of Agriculture appreciates the seriousness of the situation and is, I believe, devoting more attention and more money to it than to any other one subject at present engaging the attention of that great army of scientific workers.

Much scientific and practical information has been obtained regarding the boll weevil, and the institutes will be able to largely influence adoption of the methods that may prove best suited to the demands.

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U. S. DEPARTMENT OF AGRICULTURE.
OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 155.
A. C. TRUE, Director.

AGRICULTURAL INSTRUCTION FOR ADULTS IN THE BRITISH EMPIRE.

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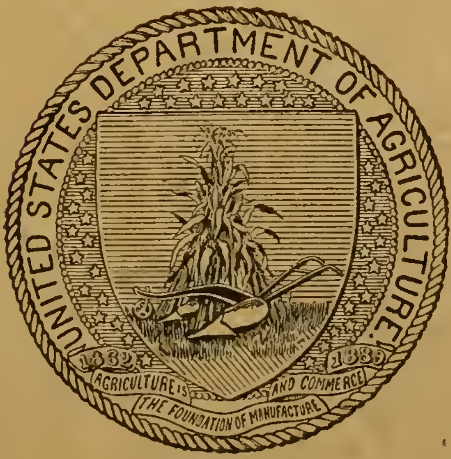

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LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON FARMERS' INSTITUTES.

Bulletin No. 79. Farmers' Institutes: History and Status in the United States and Canada. By L. H. Bailey. Pp. 34.

Bulletin No. 110. Proceedings of the Sixth Annual Meeting of the American Association of Farmers' Institute Workers, held at Buffalo, N. Y., September 18 and 19, 1901. Edited by A. C. True, D. J. Crosby, and G. C. Creelman. Pp. 55.

Bulletin No. 120. Proceedings of the Seventh Annual Meeting of the American Association of Farmers' Institute Workers, held at Washington, D. C., June 24–26, 1902. Edited by A. C. True and D. J. Crosby for the Office of Experiment Stations and G. C. Creelman for the association. Pp. 119.

Bulletin No. 135. Legislation Relating to Farmers' Institutes in the United States and the Province of Ontario, Canada. By John Hamilton, farmers' institute specialist. Pp. 53.

Bulletin No. 138. Proceedings of the Eighth Annual Meeting of the American Association of Farmers' Institute Workers, held at Toronto, Ontario, June 23–26, 1903. Edited by W. H. Beal for the Office of Experiment Stations and G. C. Creelman for the association. Pp. 119.

Bulletin No. 154. Proceedings of the Ninth Annual Meeting of the American Association of Farmers' Institute Workers, held at St. Louis, Mo., October 18–20, 1904. Edited by W. H. Beal and John Hamilton for the Office of Experiment Stations and G. C. Creelman for the association. Pp. 91.

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Farmers' Institutes in the United States. By John Hamilton. Prepared for distribution at the Louisiana Purchase Exposition. Pp. 20.

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 155.

A. C. TRUE, Director.

AGRICULTURAL INSTRUCTION FOR ADULTS IN THE BRITISH EMPIRE.

BY

JOHN HAMILTON,
FARMERS' INSTITUTE SPECIALIST.

1862 1889

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., May 10, 1905.

Sir: The act of Congress making provision for the appointment of a farmers' institute specialist in the Department of Agriculture defines his duties to be " to investigate and report upon the organization and progress of farmers' institutes in the several States and Territories. and upon similar organizations in foreign countries, with special suggestions of plans and methods for making such organizations more effective for the dissemination of the results of the work of the Department of Agriculture and the experiment stations, and of improved methods of agricultural practice."

The condition of the farmers' institute work in the States and Territories of this country has been to some extent ascertained, and its principal features have been presented in the several reports of the institute specialist to the Director of the Office of Experiment Stations and in circulars and bulletins of information issued by the Office. Suggestions have also been offered, accompanied with plans and methods for rendering the institutes more effective for the dissemination of the results of the work of the Department of Agriculture and the experiment stations.

Compliance with the remaining specification of duty enjoined by the act of Congress, namely, " to investigate and report upon the organization and progress of similar institutions in foreign countries," has been delayed owing to the difficulties attending the conducting of foreign correspondence and to the pressure of other duties connected with the work of the institute specialist.

The accompanying manuscript, entitled "Agricultural Instruction for Adults in the British Empire," gives the result of such investigations as the farmers' institute specialist of this Office has been able to make respecting the methods that have been adopted by the various governments included in the British Empire in the dissemination of agricultural information among their rural populations.

In some instances it has seemed necessary, because of the relation that unites this form of instruction with the general system of public education adopted by the respective governments, to discuss with some particularity the higher institutions of learning, at least so far as their work is associated with that of agricultural instruction of adult farmers.

The manuscript is recommended for publication as Bulletin 155 of this Office.

Respectfully,
A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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INTRODUCTION.

The position that agriculture occupies in the British Empire is one of first importance, and for many years the Government has given special attention to its development. The unusual interest manifested is no doubt partly due to the fact that those who control British legislation are, for the most part, landed proprietors, and are therefore personally injured by the decline of this industry and profited by its proper advancement. Aside from this motive of self-interest, there is also the great national problem of feeding the multitude of working men who are engaged in manufacturing occupations throughout the British Isles.

Special attention by the Government to this industry has been necessary also by reason of the diverse character of the British possessions. Located as they are in every continent, with every variety of soil, climate, and production, with densely populated districts, as England and Ireland, and those sparsely settled just emerging from primitive conditions, as portions of Australia and the Northwest Territories of Canada, the British Government has been compelled to carefully study the entire field of agricultural production, and devise means whereby the interests of this great industry can best be advanced in all of the countries under her control, and endeavor to put in operation such agencies as would most effectually assist in increasing agricultural production and in economizing its cost.

Her problems have been to discover how in her older settled districts the fertility of her lands may be increased while producing abundant crops, and in her newer provinces how primitive soils may be economically brought to tillage conditions and their productive capacity not only be maintained but gradually increased.

The conclusion reached years ago by Great Britain's wisest statesmen was that the only solution of the question of improving agriculture sufficiently to enable those who pursue it as a calling to maintain themselves in comfort for all time to come, and at the same time to produce a surplus sufficient for the use of those engaged in other occupations, lies in the proper education of those who conduct its operations.

Accordingly the Government established schools and colleges of agriculture at home many years ago, and has since encouraged their erection in all of her dependencies until now agricultural education in some form or other is given in almost every country under British rule. State departments of agriculture have been established and equipped with scientific apparatus, and officered by expert officials who devote all of their time to the interests of agriculture. Universities, colleges, normal schools, academies, secondary schools, common schools, and numerous special classes are everywhere in operation. In almost all of them the giving of instruction in agriculture is made obligatory.

Although the purpose of this publication is to present the methods in use in providing for the education in agriculture of the adult rural population through the agency of itinerant teachers, it has been found that this instruction work is in many instances so combined with the system of general education that prevails as to be practically inseparable from it. In some of the countries, for example, the institutions for higher education engage in the dual service of instructing the youth in agriculture in fixed schools, as universities, colleges, and high schools, and also in the work of carrying information to the adult agricultural population by means of traveling schools and itinerant teachers who visit localities, hold institute meetings, and instruct temporary classes in special farming subjects.

Where this method is adopted as in England, it has been necessary, in order to its proper understanding, to give with considerable particularity the details of the entire educational system, and also the connection that exists between the form of instruction conducted by the universities and colleges, and that organized and operated by the district governments.

The giving of instruction in agriculture to adults by itinerant methods is no longer an experiment in foreign countries, and work in this direction is regarded by educators and the public generally as being equally important with that performed in the class rooms of the colleges and higher technical institutions. It has become a recognized part of their educational system, as necessary as the college, the high school, or the university, and the character and qualifications of the instructors engaged in this form of education are in most of the countries fully equal to those of the professors in the old-established institutions.

The high estimation in which peripatetic instruction is held abroad is shown by the following memoranda on this subject by the Right Hon. Horace Plunkett, vice-president of the department of agriculture and technical instruction for Ireland, who was a member of the recess committee of Parliament appointed to visit continental countries and make investigations and report upon the various systems of agricultural education in use in these countries. He says:

> If there is one feature of agricultural education which, having been tested to the utmost in every country of the world, has stood that test better than any

other, it is the itinerant instructor. In our searches, at the time of the recess committee, this was a feature which in every country the demonstrator and educationist laid stress upon as showing, invariably, the most fruitful results, and all of the experience of the department since has confirmed us in the faith, which experience both in England, Scotland, the Continent, and in Canada and America had implanted in our minds.

The methods in use in the British Empire for disseminating agricultural information among the rural population are worthy of careful study by the farmers' institute workers and other agricultural teachers of the United States. They are the result of many years of experiment in agricultural education by the most capable and practical agriculturists and scientific experts of the Old World. Out of this long experience and careful study there have been evolved the present forms of agricultural education that have stood the test of years of actual operation, and have had their value demonstrated by the results that have been accomplished in the improvement of agriculture wherever they have been fairly tried. They have supplemented the elementary and primitive forms by which farmers undertook to instruct themselves through neighborhood meetings for conference and exchange of views, substituting for these disputatious methods, which too often left the audience in doubt and the contestants unconvinced, local and itinerant schools of instruction, taught by capable specialists of acknowledged attainment and experience, whose statements are substantiated by results secured on experiment farms and demonstration fields.

In preparing this bulletin for the use of farmers' institute workers of the United States, the value of the methods adopted by the several governments in providing for agricultural education and for distributing agricultural information, as compared with those in use in this country, is so much a matter of individual judgment that no discussion of that feature has been attempted, it being thought best to simply collect the facts and leave the determination of their value to the individual student who may wish to perfect the methods in use in his own State or locality.

A comparison of the farmers' institute systems that prevail throughout the United States with the methods of instruction found to be most satisfactory in the countries comprising the British Empire will no doubt convince the student that there is room for improvement in our American methods, and perhaps will induce some of those in charge of the institute work in the United States to adopt so much of that which has been successful abroad as our conditions and circumstances seem to justify.

JOHN HAMILTON.

AGRICULTURAL INSTRUCTION FOR ADULTS IN THE BRITISH EMPIRE.

AUSTRALIA.

In order to properly understand and appreciate the value of the methods used in Australia in reaching the rural population with suitable information adapted to the diverse agricultural conditions that exist throughout the Commonwealth, knowledge of the variety of crops grown, the extent of the population, and the vast area of territory to be covered is necessary.

The six States that compose the Commonwealth had in 1901 a population of 3,773,370 and a total area of 2,973,076 square miles. This is about equal in extent to that portion of the United States which lies east of the Rocky Mountains. The sparse settlement of the country is better realized by comparing the areas of the several States with that of Ohio, which contains 41,060 square miles and has a population of 4,157,545:

State:	Area in square miles.
New South Wales	310,700
Queensland	668,497
Victoria	87,884
Western Australia	975,920
South Australia	903,690
Tasmania	26,385
Total	2,973,076

The eastern section has an abundance, and in some localities a superabundance, of rainfall, but the interior and western parts are very deficient in this respect, the annual rainfall varying in these sections from 20 inches to almost nothing. The agriculture of the country, therefore, necessarily varies according to the locality. The east, with its mild and moist climate, the annual rainfall averaging from 50 to 80 inches, is devoted largely to the production of cattle and sheep: the south and west to the growing of grain.

Each State has a department of agriculture engaged in endeavoring to solve the particular agricultural problems that are peculiar to it. Among these is that of disseminating information among farming people of a kind that will aid them in overcoming the obstacles that confront them in their agricultural operations. In undertaking this, various methods have been adopted by the several States, the manifest intention being to adopt such methods as are best adapted to the peculiar conditions that prevail as to climate, crops, and population.

The following table giving the acreage under cultivation in each of the States and the percentage of each crop grown exhibits the diversity of condition that prevails, and is of interest as showing the variety of products that can be grown in this island continent:

Acreage and percentage of each crop grown in Australia.

	New South Wales.	Victoria.	Queensland.	South Australia.	Western Australia.	Tasmania.
Cultivated acreage	1,426,166	2,165,693	52,527	1,821,137	84,516	64,328
Wheat per cent	58.4	68.6	12.5	81.3	45.4	28.6
Corn do	8.8	.3	26.2		.1	.1
Barley do	.3	2.5	1.8	.7	2.1	3.4
Oats do	1.2	8.6	.2	.9	2.1	20.0
Potatoes do	1.4	1.8	2.5	.4	1.5	12.0
Hay do	22.7	14.3	14.0	13.9	42.3	18.8
Vines do	.4	.9	.5	.9	1.7	
Sugar cane do	.9		26.3			
Other crops do	5.9	3.0	16.0	1.9	4.8	17.1
Total do	100.0	100.0	100.0	100.0	100.0	100.0

There is no national system of farmers' institutes in Australia. The organization and control of the work is altogether committed to the agricultural departments of the several States. These departments have not united upon a single method, but each has formulated a separate and distinct system.

In order, therefore, that the various methods in use may be clearly presented, it becomes necessary to take them separately and discuss them under the names of the States with which each is identified.

NEW SOUTH WALES.

Nothing corresponding to the farmers' institute system of the United States is in operation in New South Wales.

QUEENSLAND.

Queensland has no system of instruction for farmers corresponding to that of the farmers' institutes of the United States. There is a State department of agriculture and there are local agricultural societies, but the function of the local societies is principally confined to the holding of an annual show. The State department occasionally sends out one of its members to address an agricultural meeting, but this work of instruction is not organized so as to be a part of the educational system. The department, however, is equipped with a corps of specialists, who give advice to farmers and visit various sections to study the agricultural conditions that exist, with a view to suggesting methods of improvement. This force consists of the principal of the Queensland Agricultural College, the agricultural chemist, the botanist, entomologist, an instructor and assistant instructor in fruit culture, a viticulturist, tobacco expert, instructor in coffee culture, a quarantine inspector, the director of the botanical gardens, the manager of the State nursery at Kamerunga, the manager of the State farm at Westbrook, manager of the State farm at Hermitage, manager of the State farm at Biggenden, manager of the State farm at Gindie, and the chief inspector of stock.

The honorable secretary of agriculture for Queensland, in his report for the year 1901, in commenting upon the lack of organization for agricultural improvement in that State, makes the following statement:

> The two causes assigned for the satisfactory condition of agriculture in the more progressive States of Europe are the extent to which cooperation and combination prevail among the farmers and the extent to which the principles of scientific tillage are diffused among them.
>
> Queensland has many agricultural societies, but there seems to be no machinery by which they may be brought to combine readily for any purpose; no central body empowered to speak in behalf of all or even a majority of the societies has yet been called into existence.
>
> It is to be added that, beyond holding shows and bestowing prizes for exhibits not exclusively agricultural, these societies have done little or nothing to reproduce here in any fullness the continental model.

SOUTH AUSTRALIA.

In South Australia the work of disseminating agricultural information among farmers is in the hands of an agricultural bureau. This bureau is a subordinate division in the department of agriculture and consists of a board of twelve members, who hold office by appointment and serve without salary. Each member of this central bureau or board is a specialist distinguished for service in some important line of agricultural industry.

The bureau upon application of at least six residents of a district is authorized to appoint subordinate branches, distributing them throughout the country at points not nearer than 12 miles from any established branch. The membership of a branch is limited to 15, but there can be an unlimited number of honorary members. The difference between the two is that the honorary members are not eligible to hold office, to be appointed as official delegates to the annual congress of branches, or to receive free the Monthly Journal of the department.

The members of the branches are appointed by the central bureau, known as the "council of agriculture." Beyond this, and in being debarred from discussing purely political questions, they are self-governing.

The branches usually meet monthly, except during the harvesting seasons. At these meetings they discuss papers prepared by their own members or criticise papers by other branches or reports of the departmental work and experiments. No special officer or officers of the state department are appointed to visit these meetings, but whenever possible the different experts attached to the department do what they can in this direction.

In addition to the ordinary meetings, neighboring branches in various districts combine to hold a conference to which the department always endeavors to send one or more representatives. The branches also arrange for field trials of implements, shows of produce and stock, pruning demonstrations, meetings at homesteads, factories, etc., where information of value is likely to be obtained.

Each year in the spring a general congress of the bureaus is held in Adelaide, and the department provides free railway transportation for two representatives from each branch. This gathering extends, as a rule, over three days, and occurs on the occasion of the spring show of live stock and implements, held under the auspices of the Royal Agricultural and Horticultural Society.

Generally the bureau may be termed a cooperative organization for the dissemination of information through the interchange of experiences of the members. The branches find their own meeting rooms, light, etc., while the department finds stationery and postage, and provides such agricultural literature as is available and also arranges at different times for experiments with manures, seeds, spraying of trees, etc.

No member of the bureau receives pay in any shape or form from the department, and the members of the subordinate branches likewise perform such service as the organization requires without compensation.

The bureau has been in existence since 1888. In 1899 there were 1,400 active members connected with the various branches, and in 1901 106 branches were reported.

The twelfth annual conference, held in 1900, was attended by 215 representatives of the branches. The secretaries furnish reports of the monthly meetings to the department. In 1901 806 such reports were made to the central bureau for that year. These are condensed and published in a monthly journal called the Journal of Agriculture and Industry, a copy of which is sent free each month to every member of each branch. The membership are thus kept in touch with what is being done by the various branches elsewhere throughout the State.

The State appropriates for the use of the bureau annually about $4,000, which is used in the publication of the official journal, for postage expenses incurred by the several branches, and for other administrative items. About $2,500 additional is also appropriated for salaries of the secretary, clerks, and other employees engaged by the bureau in administering its work.

A feature of the system that is distinctive is the gathering and publishing of the papers and addresses presented before the various branches in a monthly journal, which is distributed to the active membership in all of the branches throughout the State. By this means there is kept up a degree of interest and mutual helpfulness that has been found to be of great service.

The practice of assembling representatives from all of the branches in a general conference each year is also worthy of careful consideration. Perhaps the most radical departure from the methods usually adopted in the forming of local organizations is in the "appointing" of the active membership by the central bureau and limiting the number to 15 in any one branch. By this means those responsible for the work of the branches are selected from among the most successful and intelligent farmers. This insures efficient administration. At the same time the system of honorary membership permits the general farming public also to have the advantage of the educational work of the association.

TASMANIA.

The methods employed for the improvement of agriculture in Tasmania are much the same as those in use in South Australia. Each has a central administrative board and a system of branch boards extending throughout the rural districts with limited membership and holding monthly meetings for the discussion of practical matters relating to agriculture. The organization was created by act of Parliament in 1891 and is officially known as the council of agriculture. It consists of eleven members elected by the local branches for a period of two years. The president of the council is chosen by the members from among their number. The secretary is appointed by the governor on the recommendation of the council and must not be a member of that body. The council is required to meet at least once every two months, and the proceedings of these meetings are published in the official journal of the council.

The act provides that the powers and duties of the council shall be—

(1) To appoint boards of agriculture, nominated by five persons in any district in which no board of agriculture exists, and to maintain correspondence and cooperation with all boards of agriculture with a view to advance the interests of agriculture generally.

(2) To collect and publish, by means of the press and by aid of the boards of agriculture, information of every kind calculated to prove beneficial to colonists

engaged in agricultural, horticultural, pastoral, and other pursuits connected with the culture of the soil.

(3) To employ from time to time, with the approval of the governor in council, persons competent to give instruction of a practical character in matters appertaining to agricultural or horticultural science, and to arrange for occasional lectures on subjects of interest to cultivators of the soil.

(4) To furnish, under restrictions and regulations authorized by the council and approved by the minister, analyses of soils and manures free of cost to agriculturists.

(5) To supply, under the direction of an expert, small parcels of seeds, plants, trees, and manures for experimental purposes to such persons as are willing to undertake the conduct of experiments in accordance with regulations promulgated by the council.

(6) To arrange for holding occasionally an agricultural congress, at which the council and the boards of agriculture may be represented, for the purpose of advancing generally the objects of the council.

(7) To furnish annually to the minister, for presentation to Parliament, a general report of the proceedings of the council, together with an audited account of the receipts and expenditures for the year.

In carrying out the provisions of the above act the members of the council direct the expenditures voted by Parliament in aid of agriculture, and also pass upon the qualifications of persons recommended for membership in the various branches, receive reports of the proceedings of the meetings of the branch boards, and publish abstracts of these reports in the Monthly Agricultural Gazette, which it edits and distributes free to the members of the various branches. The board likewise has prepared from time to time and publishes circulars of information and pamphlets upon agricultural subjects, which it supplies to the membership free of cost.

The council has now in its employ four persons whom it sends out to lecture before the branch meetings. One gives instruction in dairy husbandry, one in poultry rearing, one is an entomological expert, and the fourth lectures upon agricultural chemistry. These lecturers are employed by the year and are paid by the State from appropriations made for that purpose.

In addition to the work of lecturing before the branch boards these experts are sent to give advice to individual farmers whenever requests are made which the council deems worthy of special attention. When visits of this character are made notice is usually published in advance throughout the neighborhoods where the visits occur, and farmers from the surrounding country are invited to be present and witness whatever takes place. For some years a traveling dairy school has been in operation, equipped and sent out under the direction of the council. The conditions upon which a course of instruction in dairying is granted are the following: The committee applying—

must provide transportation of the plant from the nearest railroad station; must furnish free a building at least 20 by 15 feet in which to work the separator; also a daily supply of 50 gallons of milk; a laborer to assist in the rough work, and a sufficiency of clean water for washing the butter and cleaning up.

The society must nominate 10 pupils, either male or female, for a course of special instruction. The dairy will be in operation ten days at each place in the district, and will operate at all places required in that district before leaving for another. The product of the milk will be returned to the society committee.

BRANCH BOARDS.

The branch boards are organized and governed, as has been stated, in much the same way as those of South Australia, except that in this State the membership is not limited, but the recommendation of the council to the local board is that "twelve is a sufficient number for administrative purposes." Monthly meetings are required and regular reports to the central council. Occasional conferences, composed of a number of boards in neighboring districts are frequently held, and a general convention of delegates from all of the boards assembles annually at the capital.

HOW TO FORM A BRANCH BOARD.

The following method of procedure has been recommended by the council for the formation of a local branch board:

An active, progressive, and practical farmer resident in any district at a reasonable distance from any existing branch board, who may desire to assist himself and his brother farmers, should communicate with four or five other residents of the neighborhood and arrange for holding a meeting, preferably at his own house.

When met together they can select any number of farmers within an area not too large to act with them. The names and addresses of the gentlemen chosen should be sent to the secretary of the central council for submission to the council for approval. After approval the secretary will send to the secretary of the branch board a minute book and the necessary stationery and instructions for the working of the branch. The board must provide a place of meeting at its own cost. When once started a sufficient number of copies of the Journal of the Council of Agriculture and such other publications as may be issued by the council will be forwarded for free distribution among the members of the branch, and all seeds, plants, etc., distributed by the council will be sent through the branch and every facility offered for carrying on its work.

The powers and duties of the branch boards, as prescribed by the central council, are as follows:

(1) Record names and addresses of persons to whom seeds, cuttings, plants, etc., have been or may be supplied for experiment.

(2) Ascertain if any reports are due from persons to whom plants, cuttings, seeds, etc., have been distributed.

(3) Ascertain if any strange or alien plants or fungi, insects, or other pests exist in the district; if unknown, procure specimens and forward to the council for identification, if possible.

(4) Record any means adopted for eradicating pests and results.

(5) Record observations upon all kinds of crops cultivated in the district, weather, rainfall during the month, character of soil (where new kinds of crops are cultivated), progress, and prospects.

(6) Inquire whether any diseases or ailments exist among live stock in the district.

(7) Report all observations to the council, in order that they may be included in the periodical reports.

(8) Consider any suggestions calculated to advance the prosperity of the district.

(9) Send as soon as possible report of all practical conclusions, digest of discussions, papers read, etc., to the secretary of the council for communication by him to the press, and for publication in the Journal of the Council.

The branches from time to time recommend to the council matters of importance and of interest to agriculture for its consideration. If the council approves the recommendation, it transmits the same to the government for legislative action.

In 1903 there were 48 branch bodies in the State, all holding monthly meetings and sending in reports regularly to the central council for publication.

By means of these boards the council of agriculture is able to reach the leading farmers of the State with information that is of value and to secure their cooperation in its efforts to procure legislative assistance for the advancement of the agricultural interests of the State. The fact that the membership of the several boards is composed of the most influential and intelligent farmers in each community adds very greatly to the strength of any recommendation that may come up to the council for its approval, and the frequent reports that are made of the condition of agriculture and its needs in the various districts, published and distributed to all of the branches, provides an educative means that might well be adopted by every country that is endeavoring to assist agricultural people.

VICTORIA.

Short courses of instruction in agriculture for farmers and farmers sons were inaugurated in 1902 by the director of agriculture for Victoria. The classes were to be held during the winter months, as being less likely to then interfere with farming work than at any other season. In organizing the classes, use was made of existing agricultural societies in the several districts, whose cooperation was solicited by inviting them to secure the names of farmers and farmers' sons or persons working on farms who were desirous of having short courses established in their district.

The first class was organized at Tatura, August 26, 1902. The course extended through two weeks. Three classes only were held during that year.

In 1903 there were six classes and the courses were extended to four months. The average attendance of students at the several points was 42, 25, 19, 47, 35, and 20. These averages do not include the numerous visitors who were present at most of the meetings.

In 1904 classes were held in seven centers, each class continuing four weeks, with an average daily attendance at each center of 55, 38, 33, 26, 65, 35, and 52. Eighteen lecturers were employed in giving instruction, each representing some specialty in agriculture. The meetings were held during the afternoon hours, with an occasional lantern lecture in the evening.

At the completion of each course there is an examination, any pupil being at liberty, however, to take it or not, as he prefers. If he elects to take it, and passes, a certificate of the fact that he has passed is given to him, and he is then in position to contest for certain prizes that are offered for the best examination papers presented.

The following schedule of regulations prescribed for the short courses of instruction for farmers and farmers' sons, held in 1903, in the towns of Horsham, Boort, Kyneton, Ballarat, Geelong, Shepparton, Maffra, and Warrnambool, explains the conditions under which these classes are conducted:

Instruction will continue for a period of four weeks in each center.

Three lectures will be delivered in the afternoon of each day for five days a week.

No charge will be made for instruction.

Farmers and farmers' sons, or men who have worked at least one year on the land, are eligible for admission.

Those attending may be of any age over 16 years.

No entrance examination will be held.

A final examination in every subject will be held, but attendance at this examination will be optional.

Those who pass the final examination with credit will be awarded a certificate.

The Australian Natives' Association will present a gold medal to the most successful student of all those attending the short courses of instruction.

A free library, consisting of approved text-books, will be available, under regulations, during the month at each center.

Classes will be formed at the above-mentioned towns if the following conditions are complied with:

(1) At least 40 eligible students must be enrolled before May 15.

(2) The agricultural society or some local body must bear all local expenses, such as providing a suitable hall, advertising in local papers, etc.

If the above conditions are not complied with no class will be held in that particular center this year.

These classes are not intended for local students only. Any farmer or farmer's son in the State of Victoria may attend.

Arrangements have been made with the railway department that return tickets available for one month will be issued to those traveling to attend the classes at holiday-excursion fares.

Such tickets will be obtainable on presenting a certificate to the station master, signed by the secretary of agriculture, stating that the passenger is a student proceeding to attend a course of instruction at one of the centers.

The secretaries of agricultural societies will prepare a list of respectable and comfortable lodgings.

Intending students should, consequently, correspond with the secretaries of agricultural societies regarding rooms.

A comfortable room with board can be had for 17s. to £1 a week in each center.

During the course at Geelong instruction will be given in analytical chemistry and wool sorting for three hours in the forenoon, viz, from 10 a. m. to 1 p. m., during five days in the week. This addition to the course is for the purpose of occupying the whole time of the students who come from a distance and lodge in the town. Consequently those who attend from other parts of the State should select Geelong.

As accommodation is limited for analytical work and wool sorting, preference will be given, first, to students coming from a distance; and, secondly, to those who travel to Geelong daily by train.

A charge of 6s. will be made for chemical apparatus, payable only by students who take the class in analytical chemistry.

The following programme of a four-weeks' course of the agricultural class held at Nhill shows the order in which the several topics are presented:

PROGRAMME OF LECTURES.

First week.

March.
Tuesday, 1, 3–4 p. m. Introductory lecture on the principles of manuring.
Wednesday, 2, 10.30 a. m. Land surveying, stack and dam measurement.
2–3 p. m. Farmyard manure.
3–4 p. m. Introductory lecture on principles of chemistry.
4–5 p. m. Insect pests and plant diseases.
Thursday, 3, 10.30 a. m. Land surveying, stack and dam measurement.
2–3 p. m. Lime and its functions in agriculture.
3–4 p. m. Theoretical chemistry.
4–5 p. m. Insect pests and plant diseases.
Friday, 4, 10.30 a. m. Land surveying, stack and dam measurement.
2–3 p. m. How to cultivate for wheat growing.
3–4 p. m. Theoretical chemistry.
4–5 p. m. Insect pests and plant diseases.

Second week.

Monday, 7, 2–3 p. m. Commercial fertilizers.
3–4 p. m. Theoretical chemistry.
4–5 p. m. Valuation of artificial manures.
Tuesday, 8, 10 a. m.–1 p. m. Demonstration of breaking and handling horses.
2–3 p. m. Theoretical chemistry.
3–5 p. m. Veterinary science.
Wednesday, 9, 10 a. m.–1 p. m. Demonstration of breaking and handling horses.
2–3 p. m. Theoretical chemistry.
3–5 p. m. Veterinary science.
8–10 p. m. Veterinary science.

Thursday, 10, 10 a. m.–1 p. m. Demonstration of cattle spaying.
2–3 p. m. Manures for the northern areas.
3–4 p. m. Agricultural chemistry.
4–5 p. m. Seeds—structure and development.
Friday, 11, 2–3 p. m. Rotations and their possibilities in the north.
3–4 p. m. Agricultural chemistry.
4–5 p. m. The plant—stem, bud, leaves, and their functions.

Third week.

Monday, 14, 2–3 p. m. The principles of stock feeding.
3–4 p. m. Agricultural chemistry.
4–5 p. m. Flowers—arrangement, structure, and fertilization.
Tuesday, 15, 2–3 p. m. Food requirements of the working horse.
3–4 p. m. Agricultural chemistry.
4–5 p. m. Fruit—structure and methods of seeding.
Wednesday, 16, 10 a. m.–1 p. m. Care of foals—treatment of feet.
2–3 p. m. Agricultural chemistry.
3–5 p. m. Importance of poultry industry, locality, etc.
Thursday, 17, 10 a. m.–1 p. m. Shoeing, surgical shoes, fitting, etc.
2–3 p. m. Agricultural chemistry.
3–5 p. m. Breeds of poultry, food and feeding, etc.
Friday, 18, 2–3 p. m. Agricultural chemistry.
3–5 p. m. Poultry diseases—cause and cure; chickens, etc.
8–10 p. m. The poultry industry.

Fourth week.

Monday, 21, 2–3 p. m. Diseases of cereals.
3–4 p. m. Agricultural chemistry.
4–5 p. m. Diseases of cereals.
Tuesday, 22, 2–3 p. m. Agricultural chemistry.
3–5 p. m. Demonstrations in poultry dressing.
8–10 p. m. Demonstrations in poultry dressing.
Wednesday, 23, 2–3 p. m. Agricultural chemistry.
3–5 p. m. Sheep breeding, wool shearing, preparation.
Thursday, 24, 2–3 p. m. Agricultural chemistry.
3–5 p. m. Large clips, skirting, rolling, etc.
Friday, 25, 2–3 p. m. Agricultural chemistry.
3–5 p. m. Small or farmers' clips, classing, etc.

A report by the officer intrusted with the management of the classes for the year 1904 contains the following statement:

> I have been much impressed by the evident desire of the students at all centers to learn. The lectures were closely followed and notes made by the majority of the students. * * * It is not too much to assume that the short course system of lectures has proven a success. Three years only has it been on trial, and yet it is safe to say that it has thoroughly commended itself to the practical mind of the farmer.

The director of the agricultural department of Victoria, in discussing the subject of agricultural education in his annual report of the department for 1904, takes up the question of the education of the adult rural population along agricultural lines. He states that—

> The department of agriculture has for years had officers on the staff whose duty it has been to give single lectures on agricultural subjects to meetings of farmers held under the auspices of agricultural societies. This work, although useful and interesting, can not be called very educational, as the information given in one lecture does not lead to a better understanding of the next. To meet this difficulty I have had classes of instruction for farmers and farmers' sons, extending over several weeks, held during the last two seasons, and this winter the classes are more popular than ever. * * * This method of instruction has come to stay in Victoria and will extend over the whole of Australia. Inquiries have reached me from other States, and it is only a matter of time before Australian agriculturists will realize that this is the best method of instruction for the greatest number which can be had at the least sacrifice of time and money. However excellent this system may be, the winter season as a rule is the only time farmers and their sons can devote their days to lectures and study. To meet all demands for classes during the winter months the department would be required to maintain for a whole year the staff of lecturers, who would work for three or four months only, or depend upon picking up suitable men for the work during the winter season.
>
> Engaging men specially can be done to a small extent, but if it were attempted on any large scale failure would be the result. I, therefore, after a great deal of consideration and consultation, matured a plan of keeping the lecturers employed throughout the year. The method I propose is to hold evening classes of two weeks' duration at farmhouses, the number of farmers attending at any center to be from 10 to 12 and the classes to be held the year round, excepting in the winter time, when the officers would be engaged at the farmers' classes held in each township, as is being done at present.
>
> The lectures would be held in the evening, say one and one-half hours' lecture and one-half hour devoted to the asking and answering of questions. Four lecturers would be required; one, who would arrive on a Monday and stay three days, giving lectures and discussing such subjects as manuring suitable to the district, tillage, rotation of crops, and kindred topics. On the fourth day he would leave for another center, say 20 miles away, and would be replaced by an officer competent to lecture on farm stock, their breeding and management. In two days the second lecturer would leave, being replaced by a third, who might lecture upon poultry. Two days later this lecturer would be replaced by a fourth, who would lecture on other agricultural subjects. The course of instruction at this farmhouse would then terminate after ten days' duration.
>
> Four classes, therefore, would be in progress at one time in farmhouses sufficiently far apart to prevent overlapping, and yet near enough for the officer to reach the next center and lecture on the same day.
>
> I propose that these farmhouse classes should be tried in August, when the farmers' classes held for a month in townships are finished and the officers are available to do the work.

By this method it is proposed to overcome the difficulty that now confronts institute directors in almost all countries—that of securing a sufficient number of capable men for the work of instruction. By employing them for the entire year institute teaching will become a profession, and many will doubtless find it to their advantage to prepare themselves for it and adopt it as a career. Day schools for adult farmers during the winter months and night schools during the summer months is a possible solution of the difficulty.

WESTERN AUSTRALIA.

No organized system of agricultural instruction for adult farmers has been adopted in Western Australia. The department of agriculture occasionally sends out experts to farmers' meetings and to individuals who apply for specific information. In addition to these a course of lectures on agricultural subjects is given by officers of the agricultural department during the winter months in the museum of the department of agriculture at Perth.

The course for 1904 extended from June 3 to September 2, one lecture each week.

The acting director of agriculture states that—

> Farms and orchards are visited by the officers of the department and instruction given on the spot. In the centers of the various farming districts lectures are given at irregular intervals. At these lectures discussion is encouraged, and when possible they are illustrated by models, views, or lime-light lantern slides.

CANADA.

The farmers' institutes of Canada are not conducted under the direction of the general government, but each provincial territorial authority organizes its work independently.

The Provinces and territories having institute organizations are the Northwest Territories—British Columbia, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island.

The Dominion department of agriculture has undertaken to aid the Provinces in their institute work by acting in an advisory capacity. The live-stock commissioner of the department is the official to whom has been committed the work of furnishing expert advice to the several Provinces and of aiding the institutes so far as the general government has gone in giving this movement official recognition.

In order to encourage the provincial directors, the Dominion department agrees, on condition that certain forms of institute organization are effected and certain prescribed rules observed by the several Provinces, to send out expert speakers to aid in institute work, paying the salaries and expenses of these lecturers from the time they leave home until they reach the confines of the Province requiring their services, and the Province requiring the services of these men pays their salary and expenses from the time they reach the confines of the Province until they return thereto on their return trip.

The purpose of the department in requiring the Province to bear a share of the expenses of these lecturers is to cause them to economize their time and to lay out their series of meetings so as not to cause undue traveling or expenses.

The Dominion department requires that full reports of the work done at each meeting by each speaker shall be made out by the institute director and be forwarded to the Dominion superintendent of institutes. The national department of agriculture is endeavoring to secure closer relations with the provincial directors of institutes by arranging to pay to the deputy minister of agriculture or the acting superintendent of farmers' institutes a certain annual sum in aid of the institute work.

BRITISH COLUMBIA.

The farmers' institute system in British Columbia was inaugurated in 1897, and, as in the other Canadian Provinces, it is in connection with and under the supervision of the deputy minister of agriculture. The superintendent of institutes is appointed by the lieutenant-governor in council, and is charged with the duties imposed by the several acts establishing the farmers' institute system of the Province. Inasmuch as the details of the entire system are fully set forth by the various acts of the provincial assembly providing for institute instruction, they are herewith presented in consolidated form as arranged for convenience of reference by the deputy minister of agriculture and superintendent of institutes.

ACTS OF ASSEMBLY RESPECTING THE ESTABLISHMENT OF FARMERS' INSTITUTES.

Her Majesty, by and with the advice and consent of the legislative assembly of the Province of British Columbia, enacts as follows:

Short Title.

1. This act may be cited as the "Farmers' Institutes and Cooperation Act."

Interpretation.

2. In the construction of this act, and the rules and regulations framed under the authority thereof, the following words and expressions shall have the meanings hereby assigned to them, unless the same be repugnant to or inconsistent with the context (that is to say):

"The department" shall mean the department of agriculture of the Province of British Columbia.

"The minister" shall mean the minister of agriculture of the Province of British Columbia.

"The superintendent" shall mean the superintendent of the farmers' institutes in the Province of British Columbia.

"Division" shall mean a division as set forth in Schedule A[a] of this act containing districts.

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[a] Schedule omitted from this publication.

"District" shall mean the district composed of the municipalities or other limitations set forth in Schedule A[a] of this act.

"Regular meetings" are those at which delegates sent by the department are present and whose expenses are paid by the department.

"Supplementary meetings" are those conducted by the local officials.

"Regular delegates" are those sent annually to assist local officers to hold regular meetings.

"Supplementary speakers" are those sent at the request of the local officers to assist said officers to hold supplementary meetings.

3. The minister may authorize the organization of farmers' institutes in any electoral or other division into which this Province now is or may hereafter be divided. The authority for the organization of farmers' institutes may be given after a petition, duly filled up and signed by at least fifteen persons who are resident in the said district, and who have paid in to the secretary-treasurer pro tem. not less than fifty cents each, has been filed in the department in the form set forth in Schedule B hereto.

4. The objects of such farmers' institutes shall be the dissemination of information in regard to agriculture, and shall include the encouragement and improvement of agriculture, horticulture, arboriculture, manufactures, and the useful arts:

(*a*) By holding meetings for the discussion of and hearing lectures on subjects in connection with the theory and practice of improved husbandry or other industrial purposes.

(*b*) By promoting the circulation of agricultural, horticultural, arboricultural, and mechanical bulletins and reports.

(*c*) By importing and otherwise procuring and distributing seeds, plants, and animals of new and valuable kinds.

(*d*) By offering prizes for essays and questions of scientific inquiries relating to agriculture, horticulture, arboriculture, manufactures, and the useful arts, and for shows or displays of agricultural products.

(*e*) For disseminating information regarding bee keeping.

(*f*) By cooperation for carrying on any industry or for any purpose relating to agriculture within the district, as provided for in section 15 of this act.

5. In granting authority for the formation of a farmers' institute under section 3 of this act, the minister shall appoint the place within such division and fix the day and hour at which the first meeting for the organization of the institute shall be held, of which the minister shall give at least one month's previous notice by advertisement in the British Columbia Gazette and in writing to the secretary-treasurer pro tem. of the proposed institute, who shall thereupon cause to be posted up, at not less than five of the most frequented places in the district, notices containing full particulars as to the object, place, date, and hour of the meeting. At such meeting the persons present who signed the petition, as provided in section 3, and such others as may have paid at least fifty cents each to the secretary-treasurer pro tem. prior to the time appointed for the meeting, for the receipt of which subscription the secretary-treasurer pro tem. shall be in attendance at the place of meeting at least one hour prior to the time for which it may be called, shall elect from among members such officers as are required to be elected at the annual meeting of such institute, which officers shall remain in office until the date of the next ensuing annual election.

6. The lieutenant-governor in council, upon recommendation of the minister, may subdivide divisions and districts in which institutes are organized under this act.

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[a] Schedule omitted from this publication.

7. Each farmers' institute organized under this act shall be known as the "[here insert the name of the district] Farmers' Institute," under which name each institute shall be a body politic and corporate.

8. The officers shall consist of a president, vice-president, and secretary-treasurer, and such number of directors as may be provided in the rules and regulations framed under the authority of this act, who shall be elected annually, and who together shall constitute a board of directors, the majority of which shall be practical farmers.

9. The superintendent of farmers' institutes shall be an officer appointed by the lieutenant-governor in council, to whom shall belong the duties assigned in the rules and regulations passed under the authority of this act.

10. Each member of an institute shall be entitled to receive a copy of all publications published by or issued under the authority of the department of agriculture for the Province of British Columbia.

11. The legislative assembly may each year set apart a certain sum of money for aiding farmers' institutes whose returns have been transmitted and who have complied with the provisions of this act and the rules and regulations that may be passed by the lieutenant-governor in council. To each institute whose membership is shown to amount to from fifteen to one hundred a sum of fifty cents for each paid-up member up to one hundred, and twenty-five cents for each paid-up member over one hundred will be allowed: *Provided*, That in case the amount so voted or set apart shall not be sufficient to cover the total amount of apportionment in this manner, then the apportionment shall be made pro rata on the same basis.

12. The council of any municipality may grant money in aid of any duly organized farmers' institute.

13. Every farmers' institute shall be entitled to receive the moneys provided for in section 11 of this act from the treasury of the Province upon the following conditions:

(*a*) That the number of members is at least fifteen, each paying an annual fee of not less than fifty cents.

(*b*) That the provisions of this act and the rules and regulations approved by the lieutenant-governor in council shall have been carefully observed.

(*c*) That all reports or returns required to be made under the provisions of this act shall have been received to the satisfaction of the department.

(*d*) That at least two regular meetings and two supplementary meetings shall be held during the year.

14. The funds of the farmers' institutes, howsoever derived, shall not be expended for any object inconsistent with those mentioned in section 4 of this act, and shall not be paid out except authorized at a meeting of the board of directors and upon an order signed by the president, or in his absence by two of the directors and the secretary-treasurer. In case payments are made by cheque issued upon a chartered bank the cheque shall be signed by the president, or in his absence by two directors and the secretary-treasurer.

15. Notwithstanding the provisions of any act in force in this Province upon application to the minister of ten or more resident and bona fide farmers of the district, such applicants may engage in and carry on, on a cooperative basis, any of the following, viz: (*a*) A farmers' exchange for buying and selling farm produce; (*b*) a cheese factory; (*c*) a creamery; (*d*) a fruit-canning, preserving, or evaporating factory; (*e*) a mutual credit association for the purpose of receiving deposits and loaning money to its members; (*f*) or in any other enterprise that may be approved by the lieutenant-governor in council as coming among the objects and within the meaning of this act, and such appli-

cants shall be construed "provisional directors" and shall possess the powers and authority mentioned in and conferred by any order in council for managing the affairs of the association until the first annual election of officers, and under this act the association shall possess all the powers of an incorporated company under the "Companies act, 1897," to hold property, to sue and be sued, make by-laws, and do all things necessary and purtenant to the carrying on of any business for the mutual benefit and profit of the members subscribing and holding stock: *Provided always*—

(*a*) That a notice of incorporation containing the names of such applicants be published in the British Columbia Gazette, for which a fee of ten dollars shall be charged;

(*b*) That no subscriber may hold or thereafter acquire more than one-tenth of the stock allotted by the association;

(*c*) That twenty-five per cent of the capital stock be subscribed at the time of making application;

(*d*) That all elections shall be by ballot, and each member shall be entitled to one vote only.

15A. Every farmers' institute organized prior to the 20th day of May, 1898, and every association incorporated prior to said 20th day of May, 1898, under section 15 of this act, shall be deemed to have been duly and completely organized or incorporated, as the case may be, according to law, and to have complied with and fulfilled every condition and requirement made and imposed by law in that behalf.

16. It shall be the duty of the secretary of the association so organized to make a return to the superintendent within thirty days after the first of January in each year, containing a full statement of the affairs of the association for the year last past, which shall include a duly audited and certified balance sheet, the number of stockholders and the amount of stock held by each, the paid-up capital, assets, and liabilities, the number and class of employees, the rate of wages paid in each case, the quantity and value of output, and the quantity and value of goods sold and exported. Such statement shall be certified to by the secretary as correct and by the president, or in his absence by two of the directors.

17. The procedure for the liquidation, winding up, and disposal of the business of any association under this act shall be that prescribed by the lieutenant-governor in council by order in council from time to time in that behalf.

18. The penalty for infraction of section 16 of this act shall be a fine of not less than one dollar and not more than twenty dollars for each offence upon summary conviction before a stipendiary magistrate or two justices of the peace having jurisdiction in the district, who shall have power to impose costs and order distraint in default of payment.

19. It shall be competent for any agricultural, horticultural, or dairyman's association at present in existence to be incorporated or amalgamated with the district farmers' institute in which such association is situated upon the majority vote of the members of such association at the regular meeting being passed in its favor, providing that prior to the holding of such regular meeting at least sixty days' notice shall be given in writing to the members of the intention to move a resolution to that effect, and if thought advisable by a notice published in a newspaper circulating in each division; and in case of such incorporation or amalgamation the combined associations and district institute shall be entitled to any moneys voted by the legislature in support of any association or institute so incorporated or amalgamated, and shall, in addition to its proper rights, powers, and privileges, have, and may exercise, all the corporate rights, powers, and privileges of such combined associations and institutes: *Always*

provided, That all funds belonging to the society so affiliated be applied exclusively to the purposes of that society.

20. For the purposes of this act the Province shall be divided into divisions, containing districts as set forth in Schedule A.[a]

21. The minister of agriculture may employ a portion of the legislative grant, not to exceed twenty-five per cent thereof, for the promotion and assisting in the objects and aims of a farmers' central institute for the whole of the Province; such institute to be formed by delegates from the district institutes, who shall be elected at the annual meetings, as may be provided by the rules and regulations. The central institute shall be subject to the rules and regulations made under authority of this act, and its meetings shall be held not oftener than once a year, the place of meeting to be designated by the superintendent.

22. It shall be the duty of the secretary-treasurer of each district to prepare each year a full report of the work of his institute during such year, which shall include a list of members, a statement of the receipts and expenditures, and a statement of the number and place of meetings held during the year, a programme of the meetings, and the attendance at the same, such report to be transmitted to the department within thirty days after the 31st of December of each year. The secretary-treasurer of each institute shall have a salary of not less than twenty-five dollars, to be voted by the legislative assembly.

22A. The lieutenant-governor in council may each year appoint, from among the delegates to the central institute, members of a board to be known as the "advisory board." The said board shall consist of six members, two from Vancouver Island, two from the lower mainland, and two from the upper mainland. The said board shall meet at the times and places designated by the minister, and shall advise the minister upon all matters of interest to the agricultural community. The members of the board shall receive no remuneration for their services, but shall be paid their actual traveling expenses.

23. The minister shall frame rules and regulations as a recommendation to the lieutenant-governor in council, which shall define the procedure for the organization of institutes not otherwise provided for in this act, the number and duties of officers of institutes, the date and programme of and procedure governing annual and other regular and general meetings, and provide for all other things necessary for the proper working of farmers' institutes, not inconsistent with any of the provisions of this act, and the lieutenant-governor in council may authorize such rules and regulations, which shall be published in the British Columbia Gazette immediately thereafter.

24. This act shall come into force on the day of its being assented to.

Rules and Regulations.

ORGANIZATION OF INSTITUTES.

1. Subject to the provisions of sections 6 and 7 of the act, each institute shall have a distinct name.

2. It shall be the duty of the secretary-treasurer to notify without delay the superintendent of farmers' institutes as soon as organization is completed, and to forward to him a list of the names and addresses of all the members and officers and directors.

3. Membership shall terminate with the 31st day of December each year, but the membership of persons joining during the months of October, November,

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[a] Schedule omitted from this publication.

and December just preceding, and whose fees are paid, shall extend to and be good for the whole of the following year.

OFFICERS.

4. In addition to the officers referred to in section 8 of the act, there shall be one director for every ten members up to fifty, to be elected as hereinafter provided, the number of directors, however, in no case to exceed five until the membership shall reach one hundred, after which there may be an additional director for every additional twenty members.

5. One delegate to the central institute, who shall be a practical farmer actively engaged in farming or superintending a farm, shall be elected by ballot by each district institute at the annual meeting as provided by section 21 of the act.

6. There shall be elected annually two auditors to audit the accounts of the institute.

7. An executive committee of three may be appointed from the board of directors as a whole to manage any matters within the powers of the said board to perform, their duties to be those assigned to them by the said board.

8. In case the presidency is vacant, or the president does not take action within ten days, the vice-president shall act in his stead.

9. In case of the secretary-treasurer resigning or refusing to perform the duties of his office, or if by any other reason his office becomes vacant, the president, or in his absence the vice-president, shall perfom the duties of the secretary-treasurer until the vacancy be filled.

9A. In case of any vacancy occurring amongst the officers or directors of the institute the secretary, or in case of that office being vacant, the president, or in his absence the vice-president, shall immediately call the board of directors together by giving ten days' notice in writing, and it shall be the duty of the board of directors, at the time and place of meeting, to fill the vacancies by ballot from amongst the members of the institute.

10. Any change in the personnel of the directorate or executive shall be reported to the superintendent forthwith by the secretary-treasurer, or other officer acting in his stead.

Annual Meetings.

11. The institute year shall begin January 1 and end December 31. The annual meeting shall be held in the month of January of each and every year. At this meeting the officers provided for shall be elected for the ensuing year. Elections shall be by ballot. No person shall be eligible for office or entitled to vote who has not paid his fees in full for the current membership year. The executive officers for the current institute year shall, through the secretary, present to the meeting in writing, a carefully prepared report of the proceedings of the year, in which shall be stated the number of institute meetings held, the attendance at each, the total number of papers read and addresses delivered. The treasurer's report for the current year shall be presented, but shall first be audited and certified to by the auditors. The annual meeting shall be called by mailing to each member, at least ten days before the meeting, an announcement of the meeting, said announcement to specify the date, place, and hour of the meeting, and shall contain a programme of the meeting. In addition to this, if the executive deem it desirable, they may advertise the meeting by posters, or in newspapers circulating in the district.

PROGRAMME OF ANNUAL MEETING.

12. (*a*) President's report and discussion.
(*b*) Report of executive committee.
(*c*) Treasurer's report.
(*d*) Auditor's report.
(*e*) Suggestions as to holding of regular and supplementary meetings.
(*f*) Election of officers.
(*g*) Suggestions as to institute work.
(*h*) Addresses, papers, etc.

13. At the close of the annual meeting the new board of directors shall meet and transact such business as may be necessary.

14. Memorandum of proceedings shall be entered in the secretary's minute book, and a copy of the same shall be sent by the secretary to the superintendent, and shall be presented as a part of the report of the annual meeting.

15. In case any institute shall from any cause fail to hold its annual meeting at the time appointed the secretary may appoint a time for holding the same, the same procedure to be observed as in the foregoing.

OTHER GENERAL MEETINGS.

16. All institutes organized under the act shall be strictly nonpartisan and nonsectarian, and no institute shall operate in the direct interest of any party, sect, or society, but for the equal good of all citizens of the farming community, and no subject shall be presented at any institute or any discussion allowed of a political or sectarian nature, nor shall any speaker be allowed in his lecture, essay, or speech, or in any discussion to advertise wares or schemes in which he has a direct or indirect pecuniary interest.

17. It is not intended that regular delegates shall attend more than two meetings in any institute district in one year at the expense of the department of agriculture, and officers and directors are expected to lighten, as far as possible, the expenses of the delegates while in their districts, but a greater number may be arranged for if convenient and desirable.

18. Should any institute require speakers at any other period of the year to assist in holding supplementary meetings, application for such assistance shall be made to the superintendent, and, if granted, the institute requiring the services of such speakers shall pay all legitimate expenses of such persons while attending said meetings.

19. All requests to the minister for assistance to hold agricultural, horticultural, live stock, or dairy meetings shall, if possible, be made through the secretaries of the district institutes, applicants stating what subjects they wish the speakers to discuss.

20. Every meeting of an institute, except the annual meeting, shall be advertised by issuing posters, on which shall appear a programme of the meeting, giving date and place of meeting, hour of opening, the names and addresses of the speakers, the topic to be discussed by each, and all other particulars. A copy of the poster shall be sent, two weeks previous to the date of the meeting, to each postmaster and schoolmaster and to all places of public resort in the district, and copies of the programme should be sent to each member of the institute, and it shall be the duty of officers and directors to exercise due care to insure the proper posting and distribution of said bills. A copy of each poster and each programme shall be sent as soon as published to the superintendent and to each speaker advertised.

21. It shall be the duty of the board of directors, or executive committee appointed by them, to complete all arrangements within due time for the holding of the meeting.

Duties of Officers.

22. The board of directors shall have full control of the affairs of the institute. They shall arrange time and places of meetings, and shall outline the work and the policy of the institute.

23. The executive committee shall, if appointed, carry into effect the plan of work decided upon by the board of directors, and shall arrange the details of the same.

24. The president shall preside at all meetings of the board of directors and executive committee, and in his absence the vice-president shall preside, and in the absence of both, then a chairman shall be elected from amongst the members present.

25. The secretary shall have the powers of managing director, acting under the control and with the approval of the executive committee. He shall call all meetings of the executive committee and board of directors upon the authority of the president or of any two officers or directors, give notices of all meetings as required by these rules, make returns, keep correct minutes of the proceedings, and conduct all correspondence in the name of the institute. All reports and returns required by the superintendent shall be made upon forms specially provided and in the manner indicated.

26. The secretary shall keep a book in which shall be entered the names and addresses of members in alphabetical order, also a book to be used as a mailing list, which shall contain the names of parties to whom posters, programmes, etc., may be sent.

27. It shall be the duty of the secretary to prepare and submit to the executive committee the annual report and to present the final report to the annual meeting. Not later than ten days after the annual meeting he shall forward to the superintendent, by registered mail, a copy of said report, together with a copy of the treasurer's report, the name and address of each officer and director elected for the ensuing institute year.

28. On or before the 30th day of January of each year the secretary shall send a revised list of members for the current membership year to the superintendent, and quarterly thereafter he shall forward the name and address of each additional person who has since the previous return become a member of the institute. The capita grant, as provided by the act, shall be paid on membership as returned by the secretary on the 30th day of June of the current year.

29. Within one week after the close of each institute meeting or series of meetings the secretary shall forward to the superintendent a detailed report of said meeting or meetings, in which shall be stated the name of the place or places where sessions were held, the number of persons present at each session, the name and address of each person who read a paper or gave an address, and the title of the address or paper.

30. The secretary shall, when possible, retain the manuscript of all papers read at meetings of the institute by local talent, in order that he may, when required, furnish the superintendent with the same. Each institute is required to forward at least two such papers each year, which may be published as the superintendent decides. Secretaries or essayists are not required to rewrite papers before sending them to the superintendent, but may forward them as read at the local meeting.

31. It shall be the duty of the treasurer to receive and account for all moneys belonging to the institute and disburse the same under the instructions of the executive committee, without whose order no money shall be paid out. He shall also prepare in detail and present to the annual meeting a duly audited statement of receipts and expenditures.

32. He shall use such cash and receipt books, membership tickets, etc., as may be required by the superintendent.

33. An officer or director who has not during the current year attended any meeting held in his district (except when prevented by sickness), or otherwise rendered valuable assistance to the institute, shall not be eligible for reelection to office for the ensuing year.

34. It shall be the duty of the superintendent to generally conduct the correspondence relating to the institutes and to supervise the work so far as provided for under the acts and rules and regulations. Acting under the instructions of the minister, it shall be his duty to arrange for regular and supplementary delegates to be present and address regular and supplementary meetings at the request of farmers' institutes, to prepare circular letters, to receive and publish reports, to supply all forms, books, etc., to local secretaries required under these rules, and to prepare and issue from time to time suggestions to officers and directors of the institutes.

35. Every officer and director shall promptly answer all official communications addressed to him by the superintendent, and should make diligent efforts to furnish any information required of him relative to the affairs of the institute.

Procedure, Order of Meetings, Etc.

36. At any meeting of an institute, if duly advertised as set forth in these rules, 10 members shall form a quorum to do business at an annual or other general meeting when the membership is over 32. At a directors' meeting half of total number of board of directors shall form a quorum—half of five to be reckoned as three, and the half of seven as four. At an executive committee meeting three shall form a quorum. If at any meeting a quorum is not present, those present shall adjourn, and the meeting shall again be called, as prescribed in these rules.

37. The officers and directors shall act as far as practicable upon the recommendations of the superintendent, and shall submit to him, through the secretary, all questions relating to the welfare of the institute upon which advice may be required.

38. (*a*) Except by permission of the presiding officer, no member or other person shall speak other than to ask a question or to introduce or to speak to a motion.

(*b*) In the discussion following the introduction of a subject, no person shall speak more than twice, nor for a longer time than five minutes, except by a vote of the meeting.

(*c*) When a question is under consideration no motion shall be in order except the following: (1) To adjourn, (2) to postpone, (3) to amend; these motions taking precedence in the order named, and the first two shall be decided without debate.

(*d*) Before the vote is taken on any motion or amendment the president shall ask, "Is the meeting ready for the question?" The question shall not be put so long as any member desires to speak and is in order. Any member desirous of asking a question on the subject introduced may do so verbally; but if he desires to ask more than two questions, he must submit them to the secretary in writing.

39. Every member is entitled to the following privileges:

(*a*) To protest against any decision of the institute, and request his objection to be recorded in the minutes.

(*b*) To protest against the decision of the chair and appeal to the meeting, stating the grounds of appeal, which shall then be put without debate in these words: "Shall the decision of the chair be sustained?"

40. A motion to reconsider any question decided by the institute shall be in order, providing such motion be not made on the same day on which the resolution is carried.

41. Order of business for general meetings other than the annual:

(1) Calling the meeting to order by the president.
(2) Reading and disposing of communications.
(3) Reports of committees.
(4) Programme of the day and discussion.
(5) Question drawer.
(6) Adjournment.

42. Any change of address or any failure to receive the bulletins and reports issued by the agricultural department should immediately be reported to the superintendent.

43. The blank books used shall be those authorized by the department. Blank forms for reports of meetings, financial statements, list of members, membership books, mailing books, cashbooks, etc., shall be supplied by the superintendent.

MANITOBA.

The farmers' institutes of Manitoba are made a part of the work of the local agricultural societies. The societies are incorporated organizations with power to "lease, sell, alienate, and convey, or otherwise dispose of any real or personal property of the society, to borrow any money for the purposes of the society, and for the purpose of securing the repayment thereof may hypothecate, mortgage, or pledge the real or personal property of said society."

The lieutenant-governor in council is empowered to authorize the organization of agricultural societies, which authorization may begin after a petition, duly filled out and signed by at least 50 members (none of whom shall be a member of any other agricultural society), and who must have actually paid to the secretary-treasurer pro tempore not less than $1, has been filed in the department in a form prescribed by the department of agriculture of the Province, promising to continue to pay to the treasurer of the society, so long as they remain members of it, not less than $1 each annually.

The meeting for organization is called by the lieutenant-governor in council, who selects the time and place at which it is to be held. It then becomes the duty of the minister of agriculture to give public notice of the meeting by advertisement in the Manitoba Gazette and in writing to the secretary-treasurer pro tempore of the proposed society, who is directed to post up throughout the district notices containing full particulars as to the object, date, place, and hour of meeting.

When the meeting convenes those who have paid $1 to the secretary-treasurer pro tempore shall nominate and elect from among their own members 10 directors and 1 auditor. The directors so elected are required to meet within one week therefrom and elect from among themselves a president and a first and second vice-president, and either from among themselves or otherwise a secretary-treasurer, and from outside their number an auditor, who shall not be the auditor elected at the meeting by the members. A copy of the minutes of this meeting must be sent to the provincial department of agriculture within two weeks after the annual meeting. Failure to so report deprives the society of its portion of the provincial grant for the year next following that meeting.

These societies were originally organized for the purpose of holding agricultural fairs, and each society whose total receipts in any year from this source amount to from $150 to $350 shall be entitled to an equal amount from the provincial fund in aid of agricultural societies, except that " from and after the year 1900 the sum of $50 of the provincial grant shall be withheld by the minister of agriculture from those societies not engaged in farmers' institute work.

When the farmers' institute idea was taken up in the Province, instead of erecting an independent organization for conducting them they were attached to the local agricultural societies, and it was made a part of their duty to conduct the work.

The following regulations, approved by the lieutenant-governor in council, show the relation that exists between the institutes and the agricultural societies:

I. Each agricultural society shall hold at least three meetings every year other than the annual meeting, the exhibition, and the meetings specially arranged by the department.

II. At these meetings papers shall be read or addresses delivered on topics relating to agriculture, horticulture, dairying, or kindred subjects. Free discussion shall be encouraged.

III. The order of meeting is to be similar to the regular meetings of the society and under the management of the directors of the society.

IV. The department will endeavor to supply speakers to address two extra meetings each year.

V. The directors of each society shall arrange for places of meeting, advertising meetings, and pay all expenses incurred thereby.

VI. The secretary of the society shall compile all reports regarding institute work as required by the department.

Failure on the part of any agricultural society to hold institute meetings as provided forfeits $50 of the provincial grant for that year, the same being required to be withheld by the minister of agriculture from such society. The deputy minister of agriculture is the superintendent of farmers' institutes of the Province.

NEW BRUNSWICK.

Farmers' institutes were held in the Province of New Brunswick as early as 1888, but it was not until 1897 that the work was assumed by the provincial department of agriculture and a superintendent of institutes provided. The law places this work under the immediate direction of the deputy commissioner of agriculture. The system provides for local organizations in each county, no limit being fixed to the number, several counties having as many as seven, each having a president, vice-president, and secretary-treasurer, and known under a specific name and by a number received at the date of its acceptance as an institute society by the provincial superintendent.

Under the amended regulations of the agricultural act of 1888, approved June 4, 1901, it is provided that—

> Where agricultural societies now existing, or hereafter incorporated under the agricultural act of 1888 or amendments thereto, will undertake to hold meetings under regulations made by the lieutenant-governor in council under section 3 of this act, they shall in their districts be considered as farmers' institutes.

The general policy of the government in the matter of forming independent institute organizations or associating them with existing agricultural societies is set forth in the agricultural act of 1888. The act says:

> It is desirable that all agricultural societies should conduct institute work and so avoid the necessity of two organizations in one district. For this a special grant of $15 will be given by the department, and 25 cents of each membership fee received by the society shall, with the said grant, form a fund for the carrying on of the work under the institute act.

The following rules and regulations approved by the lieutenant-governor in council have the effect of law, and inasmuch as the details of the system in use in this Province in institute work are fully set forth by this, they are therefore given in full:

RULES AND REGULATIONS.

[Approved by the lieutenant-governor in council.]

1. The New Brunswick legislature having voted a sum of money for the establishment of farmers' institutes throughout the Province, a grant of fifteen dollars will be given to one institute in each district, on such conditions as are hereinafter contained.

2. The object of each local institute shall be the dissemination of agricultural knowledge in its district and the development of local talent. The officers shall endeavor to bring the rank and file of the farmers into touch with the most successful local men, that the masses may become more conversant with the best and most profitable methods of farming, stock raising, dairying, fruit culture, and all branches of business connected with the industry of agriculture. It is desirable that agricultural societies should take up this work, rather than that two organizations should be formed in the same district.

ORGANIZATION OF INSTITUTES.

3. One institute may be organized in each district of the Province, or in such other divisions as the lieutenant-governor in council may authorize.

4. The organization meeting may be called by the superintendent of farmers' institutes, or by any five farmers of the district; and at least two weeks' previous notice shall be given by advertisement in two newspapers published in the district, or by placard, in which shall be stated the object, time, and place of meeting.

5. As soon as organization is completed the superintendent shall be notified, and the names and addresses of the officers and directors shall be forwarded to him.

6. All membership shall terminate the 30th of November each year. (See clause 57.)

7. Each institute shall be known by a distinctive name and number.

OFFICERS.

8. The officers shall consist of a president, a vice-president, and a secretary-treasurer, and one or more directors from each parish included in the institute district, except in new or thinly settled districts, when directors may be elected irrespective of the parishes. The president, vice-president, and directors shall be elected annually, and together with the secretary-treasurer shall constitute a board of directors, the majority of whom shall be practical farmers.

9. There shall be an executive committee composed of the president, the vice-president, and the secretary-treasurer.

10. There shall be elected annually an auditor to audit the accounts of the institute.

11. If the secretary-treasurer resigns, or for any cause does not perform the duties of his office, or if he removes from the district, the president shall immediately issue a letter calling the officers and directors together, giving each at least ten days' notice. In the meantime the president shall perform the duties of the secretary-treasurer. At the time and place appointed the officers and directors present shall appoint a secretary-treasurer. In case the presidency is vacant, or the president does not take action within ten days, the vice-president shall assume the power of president. Other vacancies shall be filled in like manner.

12. Any change in the personnel of the executive or directorate shall be reported to the superintendent forthwith.

ANNUAL MEETING.

DATE AND PLACE OF HOLDING.

13. The institute year shall begin December 1 and end November 30.

14. The annual meeting of each institute shall be held on some date to be selected between the 1st and 30th of November of each and every year. (See clauses 16, 17, 18, and 19.)

15. The newly elected board of directors shall take office at the close of the annual meeting. The old board shall remain in office until this time.

16. Each year a meeting of the directors shall be called by the secretary to meet some time before the 15th of September. The special business of this meeting shall be to arrange for holding the annual meeting.

17. If it is thought desirable by the directors present at this meeting that a delegate or speaker be in attendance at the annual meeting the same may be arranged for through the superintendent. (See clause 34.)

18. If it is decided that a request be sent to the superintendent for a speaker to attend the annual meeting, the directors shall, in addition, select the place for holding above meeting, the date being selected by the superintendent, as in the case of winter meetings. If, however, it is decided not to ask for a speaker through the superintendent, the directors shall select both date and place for holding annual meeting, conforming with clause 14.

19. A full report of this directors' meeting shall be forwarded by secretary to the superintendent on or before the 1st day of October.

BUSINESS AT ANNUAL MEETING.

20. At the annual meeting the directors and auditor shall be elected for the ensuing year. (See clauses 8 and 10.)

21. At the annual meeting the method of election shall be by ballot or otherwise, as decided by the members present. No person shall be eligible for office or be entitled to vote at the annual meeting who has not paid his fees in full for the membership year beginning 1st December next following date of such annual meeting. (See clause 6.)

22. At the annual meeting members may suggest points in the district where institute meetings may be held during the succeeding institute year, first as to regular, and secondly, as to supplementary meetings.

23. At the annual meeting the executive officers for the past institute year shall, through the secretary-treasurer, present to the meeting in writing a carefully prepared report of the proceedings of the year, in which shall be stated the number of institute meetings held since the last annual report, the attendance at each session, the total number of papers read and addresses delivered, and a statement of the financial condition of the institute. The financial statement shall first be audited and certified thereto by the auditor.

24. The annual meeting shall be devoted to the business of the institute as specified in clauses 20, 21, 22, and 23, and in carrying out the programme of the annual meeting, and in considering ways and means whereby the institute can be improved.

25. The annual meeting shall be advertised by mailing to each member, at least ten days before the date thereof, an announcement calling the members together. Said announcement shall specify the date, place, and hour of meeting, and shall contain a programme of said meeting. If the executive committee deem it in the interest of the institute, posters and newspaper advertising may also be employed to make this meeting publicly known.

ORDER OF BUSINESS FOR ANNUAL MEETING.

26. (1) President's report.

(2) Discussion thereon.

(3) Report of the executive committee presented in writing by the secretary-treasurer.

(4) Auditor's report presented in writing.

(5) Suggestion of points at which to hold regular meeting.

(6) Suggestion of points at which to hold supplementary meeting.

(7) Election of directors, election of auditor.

(8) Suggestions as to how the institute can be improved or made more useful, if it has not already been considered by the president in his opening address and in the discussion following.

(9) Addresses, etc.

27. At the close of the annual meeting the new board of directors shall meet and elect from among themselves a president and a vice-president, and shall finally decide at what points in the district regular and supplementary meetings shall be held during the current institute year. The points selected shall be entered on page C of the secretary's minute book, and a copy of this page shall be sent to the superintendent and shall be considered as part of the report of the annual meeting.

28. The board of directors shall, at the close of the first annual meeting, and when afterwards necessary, appoint from among themselves or otherwise a secretary-treasurer, who shall remain in office during pleasure.

29. In case an institute shall, through any cause, fail to hold its annual meeting within the time specified, the superintendent may appoint a date for holding same, the meeting to be called as provided for the regular annual meeting, and this meeting shall, in all particulars, be taken as the annual meeting of the institute.

OTHER GENERAL MEETINGS.

30. In addition to the annual meeting, each institute shall hold at least two meetings each year, at which papers shall be read or addresses delivered on topics relating to agriculture, horticulture, dairying, or kindred subjects. Free discussion shall be encouraged.

31. All institutes organized under the act shall be strictly nonpartisan and nonsectarian in every phase of their work, and no institute shall be operated in the interest of any party, sect, or society, but for the equal good of all citizens and the farming community.

32. No subject shall be presented at an institute meeting, or discussion allowed, of a political or sectarian nature; nor shall any speaker be allowed in his lecture, essay, or speech, or in any discussion, to advertise wares, or schemes in which he has a direct or indirect pecuniary interest. The delegates and officers of the institutes shall see that the exercises are not subordinate to any low or frivolous entertainments, or to the aggrandizement of any individual, party, or sect.

33. The regular delegation shall visit two points only in one year in each institute district, or when said delegation spends two days at one place, that point only shall be visited. The government will defray the cost of sending these delegates, but officers and members of institutes are expected to lighten as far as possible the expenses of delegates while in their district.

34. Should any institute require a speaker or speakers at any other period during the year to assist in holding supplementary meetings, application for assistance shall be made to the superintendent at the time of reporting the annual meeting. The department will pay for the services of such supplementary speaker or speakers for two days in each year for each institute district, but the institute requiring the services of said speaker or speakers shall pay all legitimate expenses from the time said person or persons leave home until they return thereto. When a delegate or delegates address meetings in more than one district, the expenses will be equitably divided between said institutes and collected from the institute or deducted from their grant.

35. If an institute decides to hold supplementary meetings other than those asked for at the time of reporting the annual meeting, or for more than four days during one year, said institute shall pay all expenses and wages. This clause shall not apply to the annual meeting.

36. If a regular or supplementary meeting has been granted, and the time and place published in the annual bulletin, no change shall be made in said time or

place. Any institute failing to hold a supplementary meeting, published as aforesaid, shall be required to pay the expenses notwithstanding.

37. All requests for assistance to hold agricultural, horticultural, live-stock, or dairy meetings shall be made through the secretary of the district institute. Applicants should state what subjects they wish the speaker to discuss.

38. Every meeting of an institute, except the annual meeting, should be advertised by issuing posters, not less than 14 by 20 inches, on which should be printed an attractive programme of the meeting, giving date and place of meeting, hour of opening, the name and address of the speakers, topics to be discussed by each; also the hour at which each speaker will address the meeting, the time to be occupied by each address, and such other information as the executive deems necessary. A copy of said bill should be sent at least two weeks previous to the date of meeting to each postmaster, each schoolmaster, each miller, each blacksmith, and to other places of public resort in the district, which are within a radius of 10 miles of the place of meeting, with a request to post in a conspicuous place. It shall be the duty of the officers and directors to exercise diligence to insure the proper posting of said bills. In addition thereto, a programme of convenient size, containing similar information, should be distributed so as to reach its destination at least ten days previous to the date of meeting. A copy of said programme should be sent to each member of the institute, to farmers, journalists, public men, and others in the district who reside within 10 miles of the place of meeting. Such posters and programmes should announce that all interested are welcome, whether members of the institute or not. Copies of said programmes should be sent to the school-teachers in the district, with the request that they be carefully distributed among the children.

39. A copy of each poster and each programme shall be sent as soon as published to the superintendent and to each speaker advertised.

40. When institutes are notified of the dates assigned for their meetings, and are furnished with the names of the speakers and a list of topics, the executive committee should proceed to complete arrangements according to these rules. They should finally engage the hall, select local talent, etc. At least half of the time of each meeting should be occupied by local talent. The hall or other buildings to be used for the holding of the institute meetings should be lighted and heated, when such is necessary, at least half an hour before the time advertised. When light and heat are not required said places should be opened and prepared for holding the meeting at least one-half hour before the time advertised.

41. The time allowed speakers should be from five to thirty minutes, to vary according to the subject and the ability of the speaker. It is no breach of courtesy to limit each speaker to the time allotted him in the programme. When the programme has been carefully prepared on that basis no speaker should be allowed to exceed the time, to the embarrassment or detriment of the speakers who are to follow him. If the speakers are held down to their time, the work of the institute, as a rule, will be benefited. Sessions should not be too long.

42. No one should be named on a programme who has not agreed to do the specific thing he is advertised to do.

43. At each meeting of the institute a committee should be appointed to canvass the audience for members.

Board of Directors.

44. The board of directors, under these rules and regulations, shall have full control of the affairs of the institute. They shall arrange time and places of meeting when not otherwise arranged for and shall outline the work and policy of the institute.

45. The directors of each local institute shall convene each year, in the month of September, for the purpose of arranging for the annual meeting. (See clause 16.) At this meeting the order of business shall be as follows:

(1) Selection of a place for holding the annual meeting.

(2) Shall a request be sent to the superintendent for a delegate to attend the annual meeting?

(3) If it is decided not to send a request to the superintendent for the services of a delegate, the director shall select a date on which to hold the annual meeting, which shall be between the 1st and 30th of November. (See clauses 14, 16, 17, and 18.)

Executive Committee.

46. The executive committee shall carry into effect the plan of work decided upon by the board of directors and shall arrange the details of the same. (See clauses 9 and 66.)

Notice of Meetings.

47. A meeting of the directors or of the executive committee may be held at any time, provided one week's notice by letter be given to each director in the case of a directors' meeting, and a similar notice to each executive officer in case of an executive committee meeting. Meetings of the executive officers or of the directors may be held on shorter notice, provided each director or executive officer be otherwise notified and agrees thereto. (See clause 25.)

Duties of Officers.

PRESIDENT.

48. It shall be the duty of the president to preside at all meetings of the board of directors and of the executive committee. In the absence of the president the vice-president shall preside, and if both are absent a chairman shall be appointed by the committee.

SECRETARY-TREASURER.

49. The secretary-treasurer shall have the powers of a managing director, acting under the control and with the approval of the executive committee.

SECRETARY.

50. It shall be the duty of the secretary to call meetings of the executive committee and board of directors, upon the authority of the president or any two officers or directors, to give notice of all meetings as required by these rules, and keep correct minutes of the proceedings.

51. All official correspondence relating to the institute shall be conducted by the secretary or in the name of the secretary.

52. In all correspondence relating to the institute the name of the institute shall be given in full after the signature of the officer, except in cases where an official heading is used, giving the name of the institute.

53. All reports and returns required by the superintendent shall be made upon forms especially provided and in the manner indicated.

54. The secretary shall keep a book in which shall be entered the names and addresses of members in alphabetical order, also a book to be used as a mailing list, which shall contain the names of parties to whom posters, programmes, etc., may be sent.

55. It shall be the duty of the secretary to prepare and submit to the executive committee the annual report, as set forth in clause 23, and to present the final report to the annual meeting.

56. Not later than 1st day of December in each and every year he shall forward to the superintendent by registered mail, or otherwise, copy of said report, together with a copy of the financial statement, and the name and address of each officer and director elected for the ensuing institute year, and also a list of members for ensuing year.

57. On or before the 10th day of March of each year the secretary shall send a revised list of members for the current membership year to the superintendent, and on or before the 10th day of each succeeding month he shall forward the name and address of each additional person who has since the previous return become a member of the institute. (See clause 6.)

58. Within one week after the close of each institute meeting or series of meetings the secretary shall forward to the superintendent a detailed report of said meeting or meetings, in which shall be stated the name of the place or places where sessions were held, the number of persons present at each session, the name and address of each person who read a paper or gave an address, the title of the address or paper, and a comment upon its value—whether good, fair, or indifferent. (Use Form A of secretary's minute book for making returns required by this clause.)

59. On or before 1st day of October the secretary shall report to the superintendent—

(1) The name of place selected for holding the annual meeting, also the name of the hall in which it will be held.

(2) The decision of the directors as to whether or not they wish the superintendent to arrange that a speaker address their annual meeting.

(3) The date chosen for holding the annual meeting if section 2 is decided in the negative.

60. The secretary shall, when possible, retain the manuscript of papers read at a meeting of the institute by local talent, in order that he may, when required, furnish the superintendent with same. Each institute is required to forward at least two such papers each year, which may be published as the superintendent decides. Secretaries or essayists are not required to rewrite papers before sending them to the superintendent. Forward them as read at local meetings.

61. All reports, names, post-office addresses, etc., should be written in a plain, legible hand, or they may be typewritten.

TREASURER.

62. It shall be the duty of the treasurer to receive and account for all moneys belonging to the institute, and disburse the same under the instructions of the executive committee, without whose order no money shall be paid out. He shall also prepare in detail and present to the annual meeting a duly audited statement of receipts and expenditures.

63. He shall use such cash and receipt books, membership tickets, etc., as may be required by the superintendent.

64. The funds of the institute as received by the treasurer shall, when possible, be deposited in a chartered bank to the credit of the institute.

DIRECTORS.

65. Each parish in the district shall be divided annually between the directors representing the same, whose duty it shall be to make a thorough canvass for members each year. This division of territory shall be arranged at a directors' meeting held immediately after the close of the annual meeting.

66. As soon as it is decided to hold an institute meeting in a parish the directors elected to represent that parish shall form part of the executive com-

mittee until after the close of said meeting. The duties of the said directors shall be to assist, to the best of their ability, the other members of the executive committee, to the end that a successful meeting may be held in their district.

67. It shall be the duty of the officers and directors to be present at the meetings of the institute. An officer or director who has not during the current year attended the meetings held in his parish (except when prevented by sickness), or otherwise rendered valuable assistance to the institute, shall not be eligible for reelection to office for the ensuing year.

68. Every officer and director shall promptly answer all official communications addressed to him by the superintendent, and should make diligent efforts to furnish any information required of him relative to the affairs of the institute.

69. The officers and directors shall act as far as practicable upon the recommendations of the superintendent and shall submit to him through the secretary all questions relating to the welfare of the institute upon which advice may be required.

Expenditure of Institute Funds.

70. All moneys received, whether as membership fees, legislative grant, or otherwise, shall be spent within the district in which the institute operates: (1) To defray actual expenses of meetings such as are heretofore described; (2) to employ suitable persons to address said meetings; (3) to assist in circulating agricultural, horticultural, live-stock, and dairy literature or periodicals among the members, or to establish a circulating agricultural library for the use of members; (4) to remunerate the secretary and others for services rendered.

Quorum.

71. At all meetings of the institute or of the officers, if duly advertised as set forth in these rules, ten members shall form a quorum to do business at an annual or other general meeting. At a directors' meeting five shall be a quorum. At an executive committee meeting two shall be a quorum. If at any meeting a quorum is not present, those present shall adjourn, and the meeting shall again be called as prescribed by these rules. (See clauses 25 and 47.)

General Rules.

72. Each member of an institute shall be entitled to receive the publications issued by the department of agriculture for the Province of New Brunswick. Any change of address or any failure to receive the publications issued by the agricultural department should be reported immediately to the superintendent. The names of all officers and directors shall be included in the list of members.

73. The blank books used shall be those authorized by the department. Blank forms for reports of meetings, financial statements, and lists of members, membership books, mailing books, cashbooks, etc., may be had from the superintendent.

74. All institute returns shall be made to the superintendent.

Order of Meetings.

75. (*a*) Except by permission of the presiding officer, no member or other person shall speak other than to ask a question or to introduce or speak to a motion.

(*b*) In the discussion following the introduction of a subject, no person shall speak more than twice nor for a longer period than five minutes, except by a vote of the meeting.

(*c*) When a question is under consideration, no motion shall be in order except the following: (1) To adjourn, (2) to postpone, (3) to amend, and (4) those motions taking precedence in the order named, and the first two shall be decided without debate.

(*d*) Before the vote is taken on any motion or amendment, the president shall ask: "Is the meeting ready for the question?" The question shall not be put so long as any member desires to speak and is in order. Any member desirous of asking a question on the subject introduced may do so verbally, but if he desires to ask more than two questions he must submit them to the secretary in writing.

76. Every member is entitled to the following privileges:

(*a*) To protest against any decision of the institute, and request his objection to be recorded in the minute book.

(*b*) To protest against the decision of the Chair and appeal to the meeting, stating the grounds of appeal, which shall then be put without debate in these words: "Shall the decision of the Chair be sustained?"

77. A motion to reconsider any question decided by the institute shall be in order.

78. Order of business for general meetings other than the annual:

(1) Calling the meeting to order by the president.
(2) Reading and disposing of communications.
(3) Reports of committees.
(4) Programme of the day and discussion.
(5) Question drawer.
(6) Adjournment.

SUGGESTIONS TO OFFICERS OF FARMERS' INSTITUTES.

There is no general system regarding the payment of secretaries and other officers. This is a matter that must be left entirely in the control of the local officers; yet it is desirable that, if possible, a uniform system be adopted throughout the Province. The following plan is respectfully suggested:

If the institute has a membership of 50, that the secretary receive ten dollars annually and all legitimate expenses while attending meetings, whether of the institute, the directors, or the executive officers. In addition to this, he may receive five dollars for each additional fifty persons who join the institute. By this plan an institute with a membership of 200 will pay its secretary twenty-five dollars net for his services. As a rule the success or failure of an institute depends upon the secretary. If an institute has a good secretary, it will flourish; if the secretary is not up to the mark, the institute will sooner or later go to the wall; therefore the best available man should be chosen for this position, and he should be liberally dealt with.

It is not necessary for the directors to meet frequently; probably once or twice a year is often enough, viz. just before and just after the annual meeting; but the executive officers (see clauses 9 and 66) should meet much more frequently, and if the funds of the institute will allow of it, they should be paid their actual expenses when attending meetings or when engaged in institute work.

In order to increase the membership and interest, each district should be canvassed annually, as provided for in clause 75. In order to meet the expenses of each director so engaged, a commission of 25 per cent may be allowed on each subscription taken by him in the section of the parish he represents. In a thickly settled district an industrious man should take at least 20 names a day. His commission would be $1.25.

Officers whose expenses are paid otherwise than by commission should be required to exercise strict economy. A statement of all such expenses should be presented in detail at the annual meeting.

If the officer's expenses are paid while attending a meeting, he should not be allowed a commission and expenses also.

Posters and programmes should be printed in the most attractive manner possible. Each institute should adopt and constantly use a certain color of paper, ink, and a certain typographical arrangement, which would soon become familiar to the people, and therefore recognized and noticed wherever seen. Red ink on white paper makes a bill noticeable. The bill and the programme should each give, as far as possible, the same information, and the typographical appearance should be the same, the only difference being the size of the type and the size of the paper used.

The most desirable size for the poster is about 27 inches long by 14 inches wide. The paper used for posters should be not lighter than 50 pounds to the ream nor more than 60 pounds; the latter is the best weight. When tacked on a wall or pasted on boards, bills of this weight last much better than the lighter ones. They are stiffer and hang better from a cord when put up in stores.

Programmes should be printed on paper 50 pounds to the ream, and may vary in size from 5 by 10 inches to 6 by 12 inches, according to the size of the sheet from which they are cut. Sheets of this size printed on one side only will be found cheaper and just as useful as smaller folders printed on both sides.

When an officer or director is canvassing for members each should take with him copies of the publications sent free to members during the past year. By showing these many more subscriptions can be obtained.

Each person becoming a member should be given an annual membership ticket or badge, the latter preferred. When badges are used each member should be requested to wear same whenever he or she is attending institute meetings. This will tend to advertise the institute and will make more easy and effecutal the work of those selected to canvass the meeting.

When possible the institute should take the form of a farmers' club. Public meetings should be held in each parish at least once during each year; more frequently if practicable.

A sample member's card given below is a very good form:

FARMERS' INSTITUTE NO. 1.

ADDINGTON AND ELDON, RESTIGOUCHE COUNTY.

1901.

----------------- }
----------------- } MEMBER'S TICKET...... 25 cents.

Mr ....

Sold by ....

——— ———,

Secretary.

This card entitles holder to all publications issued by the department for agriculture of New Brunswick.

RULES GOVERNING DELEGATES.

1. Each speaker is expected to be thoroughly acquainted with the act and the rules governing farmers' institutes.

2. Each delegate is requested to study carefully the conditions and needs of the district to which he is sent as a speaker, and to prepare his addresses or papers accordingly.

3. The person whose name is placed first on the list in each division is chairman of that delegation, and is expected wisely to direct and control the work of that delegation, also the institute meetings to which he is sent.

4. Each delegate is requested to do all in his power to cause full and free discussion after each paper or address has been delivered, and to procure and forward to the superintendent the name and address of each successful local speaker or essayist, and to obtain all the information possible concerning such persons; also to inform the superintendent concerning the peculiar needs of the district visited as far as the institute work is concerned; also to forward a short report of each meeting. Was each gathering successful? If not, why not? After the meetings are thus reported the superintendent will be pleased to receive from each delegation or speaker suggestions or advice regarding institute work in general or with regard to any particular section. How can the efficiency of this important department of agricultural education be increased and made more valuable to the country? Each delegate or delegation is expected to give the superintendent and the officers of institutes generally the full benefit of this experience.

5. The dates of the institute meetings delegates are to attend will be published. Each delegate is expected to arrive at each place for which he is advertised at the hour named or a little before, and to continue in attendance during said meeting and enthusiastically and promptly to do his duty irrespective of what others may do. Should sickness or other serious cause intervene, the chairman of the deputation of the delegation shall telegraph the superintendent, in order that the vacancy may be promptly filled.

6. Long speeches or those calculated to advertise the property of the speaker are contrary to the rules governing institutes. Party politics in any form must be avoided by each speaker. The chairman of each delegation and the officers of each institute are expected to see that nothing of this kind occurs. Institute speakers are expected to teach practical agriculture, nothing else.

7. A check for a suitable sum to pay actual expenses of the deputation will be forwarded by the superintendent to the chairman of each deputation before the opening of the first meeting.

8. Each delegate shall pay his expenses to the opening meeting. The chairman of each respective deputation will refund said sum and will thereafter pay all expenses of the deputation. If a delegate does not know the way to reach the first place of meeting most quickly, the necessary information may be obtained by writing to the superintendent or, better still, by calling on the nearest railroad ticket agent, who will give the necessary information.

9. As soon as a delegate completes the work assigned to him he shall forward to the superintendent a bill for his time. Each delegate is also required to forward to the superintendent a copy of at least one of his addresses (the one which has proved most acceptable to the hearers preferred or the one chosen by the superintendent), and if possible a synopsis of the debate thereon and questions and replies thereto, which may be published in the annual report of the farmers' institutes or elsewhere, as decided by the superintendent. Some speakers withhold their best addresses, not wishing them published, fearing that

it would detract from their future usefulness. This is a mistake. The publication of an able address increases the demand for the speaker and the public desire to hear that particular address delivered.

10. As soon as the work of a deputation or speaker is completed the chairman shall forward to the superintendent all aforesaid reports on forms provided for the purpose. The financial statement shall be furnished in duplicate. All sums of $1 and upward must be verified by a voucher.

11. The necessary expenses of each delegate are paid by the department from the time he leaves home until said persons return thereto; but each is expected to exercise due economy. Each delegate will receive a daily remuneration for services for the time absent from home, Sundays excepted, but each must go and return by the shortest and quickest route. A check in payment for services will be sent each delegate as soon as the work assigned him or her is completed and the required returns and a copy of an address prepared by said delegate is received by the superintendent.

12. *Finally remember:* Thorough preparation is the key to success as an institute worker. If you have had but little experience as a public speaker, carefully write your papers and make them short. Use these papers to assist you when addressing a meeting. The speakers should be careful to ascertain the time limit assigned them on the programme and be sure to keep within said limit. The papers and talks should be illustrated as far as possible by means of blackboard work, charts, diagrams, models, specimens, etc. Discuss themes on which you are thoroughly and practically well informed, and use your own experience and that of others to confirm what you say. Avoid personalities. Be courteous; be helpful. Hold yourself in readiness to promote the success of the institute in every way possible. Every time you speak aim to enforce some practical lesson adapted to the needs of the audience.

Special Instructions and Explanations to Institute Officers and Delegates.

DELEGATES.

The farmers' institute system is nonpolitical in the strictest sense. (See clauses 31 and 32 of the acts and rules governing farmers' institutes.) Persons sent as delegates and officers and directors of institutes are instructed to enforce these rules to the very letter. Delegates are expected not to discuss, either directly or indirectly, political or sectarian questions while engaged as delegates, either before, after, or during the meetings. It is not necessary for them when acting as delegates even to make public their political allegiance. It is the policy of the department to send only two delegates as a deputation, and in some cases only one, but it will sometimes be found necessary to do otherwise.

The greatest care is exercised in choosing speakers. The services of specialists are obtained as far as possible, persons who have been successful in special lines, or those who are well qualified to explain profitable methods not generally followed. No attention is paid to politics, religion, or nationality when choosing delegates; they are chosen because of their qualifications only.

In some cases the delegates may not be prepared to discuss the subject the local officers deem of greatest interest. In such cases the officers should employ additional persons to deliver addresses of the character desired. These additional speakers may be chosen from the list of available delegates or elsewhere. A list of available delegates will be prepared and published each year.

If, from sickness or any other cause, a delegate who is advertised can not fulfill his engagements, another person competent to discuss similar subjects will be sent in his place. But every precaution will be taken to prevent the necessity of changes. When changes are necessary, substitutes will be chosen from among the lists of available delegates.

Delegates are not expected to deliver more than two addresses each day, and in no case to occupy more time than is allotted to them in the programme issued by the local officers. The officers of local institutes are expected to employ other speakers or essayists.

The department defrays the cost of sending regular delegates to the regular meetings; but officers, directors, and members of institutes are expected to lighten, as far as possible, the expenses of the delegates by meeting them at the railway station and conveying them free of expense to the place of meeting and returning them again to the station or forwarding to the next place of meeting.

OFFICERS AND DIRECTORS.

Institute officers and other interested parties are urged to make themselves familiar with the act and rules governing farmers' institutes and delegates, and to conduct the respective institutes as nearly as possible on the lines there laid down.

Institute officers should hold meetings of farmers and business men at points where meetings are to be held at least four weeks before the said meeting convenes for the purpose of engaging a hall and providing an evening's programme; also to secure some of the best farmers to read papers on branches of farming in which they excel, and two or three ladies to give papers on some phases of home life or domestic economy.

Delegates and officers are urged to do all they can, by the use of the question drawer and otherwise, to draw out in discussion as many as possible of those present. Call upon them personally and urge them to speak. Frequently those best qualified are least inclined to take part. Try in each case to make the discussion interesting by engaging some experienced man to follow each address and thus open the discussion. Do not allow one or two to monopolize the discussion, but make all feel that they have a part in the proceedings.

Let it constantly be borne in mind that one of the chief aims of the institution is the development of local talent and the bringing of the rank and file into close touch with the most successful local men and their methods. Do not depend altogether on the delegates; if home talent is not developed the chief benefit of the institute system is lost sight of. When a popular evening's programme is desirable (which is the case in many places) it should be entirely supplied by local talent. In every district in New Brunswick there are many young people who could be employed to assist in such meetings, and if so engaged would in all probability thereafter take a keener interest in the work of farmers' institutes. Business and professional men and their families should not only be cordially invited to take part in these meetings and help to make them a success, but they should be urged to do so. It is reasonable to expect their assistance, for the success of all classes depends on the farmer. When he is prosperous all other classes flourish.

Institute officers are urged to do all in their power to forward the interests of their local institute, and to make such suggestions to the superintendent as they think are in their interest. He is always glad to receive suggestions and advice and is grateful to the sender, but institute officers are respectfully requested not to interfere, directly or indirectly, with the affairs or conduct of neighboring or distant institutes. Each local institute is quite capable, with the aid of the department and the superintendent, of conducting its own affairs. Interference by outsiders accomplishes no good purpose and invariably does much harm. The officers and directors of each local institute are responsible for the success of the work of their respective institute districts only. The superintendent is responsible for the work throughout the Province.

In order to accommodate the farmers two series of institutes are held—one during the months of January and February and one in October and November. For institute purposes the Province is divided into three divisions, with separate sets of lecturers for each division. The Dominion department of agriculture each season sends lecturers to assist the local and provincial lecturers in giving instruction.

A feature of the work in this Province is that of holding field meetings in orchards or fields, where experts give practical demonstrations of the methods which they advocate, whether it be pruning, plowing, cultivating, grazing, budding, or planting. Over 20 per cent of the meetings held in 1903 were of this practical character.

Another peculiarity of the system is that the secretaries of the local institute societies receive compensation for their services. The amount is not very much, varying from $5 to $30 per year. No doubt this salary, small as it is, has much to do with insuring the success of the work, and gives the provincial superintendent a hold upon the local society that he would not have without it.

In 1903, 162 institute meetings were held, attended by 7,149 persons. The membership in the societies reporting ranges from 24 to over 800. Thirty-six had between 50 and 100 members, eleven between 100 and 200, and three over 200. The average cost per meeting was $8.28.

The superintendent in his report for that year states that—

> The interest in these meetings is constantly increasing, but very much of their success depends upon the local officers. If they are active men, interested in the work, and take the trouble to advertise and talk up the institute, the result has always been a good attendance. On the other hand, when the local officers are indifferent the result is generally poor.

NORTHWEST TERRITORIES, CANADA.

The farmers' institutes in the Northwest Territories of Canada are under the general direction of the territorial commissioner of agriculture, who is authorized to appoint a superintendent of fairs and institutes. The institute work is combined with that of the local agricultural societies. Where no agricultural society exists the superintendent of institutes gets some person in the neighborhood to make such local arrangements for the meetings as may be necessary. In all cases the department pays for the advertising and the rent of the halls for institute meetings.

The objects of a local agricultural society are defined in the territorial ordinance to be "to encourage improvement in agriculture, horticulture, manufactures, and the useful arts."

I. By holding meetings for the delivery of lectures and for the discussion of subjects connected with the theory and practice of any of the said industries.

II. By promoting the circulation of agricultural, pastoral, horticultural, arboricultural, and mechanical periodicals, and by the formation and maintenance of the reference library on such subjects for the use of its members.

III. By importing and otherwise procuring seeds, plants, and animals of new or valuable kinds.

IV. By holding exhibitions, as hereinafter provided, at which prizes may be awarded for—

(*a*) Excellence in the raising or introduction of live stock.

(*b*) The invention or improvement of agricultural machines or implements.

(*c*) The production of grain and all kinds of vegetables, plants, animals, fruits, home manufactures, and works of art, and generally for excellence in any agricultural production or operation.

V. By offering prizes for essays on subjects relating to agriculture, including the prevention of prairie fires and the eradication of noxious weeds.

VI. By taking action to eradicate poisonous and noxious weeds and to exterminate such animals as are found to injure or impede agriculture.

VII. By carrying on experiments in the growing of crops, the feeding of stock, or any branch of agriculture, or by testing any system of farming.

VIII. By affiliating and cooperating with associations organized to improve live stock or encourage grain growing, dairying, forestry, fruit growing, or promote the study of plant life or the destruction of injurious insects or pests.

The societies are organized by not less than 50 persons over 18 years of age and not belonging to any other agricultural society signing an application to the commissioner of agriculture and by each paying at least $1 as a membership fee, or as part of his first annual subscription to the funds of the proposed society. If the commissioner approves of the application, he declares the subscribers to be organized into an agricultural society and issues a certificate to that effect. Thereupon the society becomes a corporation, with power to hold real estate necessary for the business of the society.

The officers of the society consist of a president and 2 vice-presidents, who are ex-officio directors, and 9, 12, or 15 additional elected directors as may be determined by the society, a secretary, and a treasurer, and 2 auditors. The president, vice-presidents, directors, and auditors hold office for one year. The secretary and treasurer are appointed from time to time by the directors to hold office during pleasure. The societies are required to hold an annual meeting within the first ten days of December in each year.

Each society thus constituted is entitled to receive grants made by the legislative assembly in aid of agriculture: One dollar for each paid-up member; $5 for each agricultural experiment conducted by the society under the direction of the territorial department, and where a society holding an agricultural exhibition expends a sum in excess of $250 for prizes an amount equal to 66⅔ per cent of the amount actually paid for such prizes not exceeding $1,000.

A list of the officers elected at the annual meeting and a copy or summary of each report and statement presented thereat is required to be transmitted to the department by the secretary on or before the 23d day of December in each year, and in case these particulars are not transmitted from any agricultural society within this date it can not receive any portion of the legislative grant unless the commissioner is satisfied by the explanations given that such delay was unavoidable or inadvertent, in which case he may pay the grant after deducting $5 for each week of such delay.

The institute meetings are usually of one day's duration and often consist of but a single session. There is no regular staff of lecturers, but the superintendent depends upon securing from time to time the services of such men as he may discover to be available.

The first institute meetings, 19 in number, were held in 1899. The number has increased until in 1903 there were 106, and the amount expended for institute purposes for that year was $8,200.

The methods followed by the Territories do not differ materially from those in use in the United States, namely, meetings of farmers to which lecturers are sent by the department, who discuss various subjects relating to agriculture. The system, however, is worthy of the special attention of institute workers from the fact of its coordinating the institute work with that of the agricultural society, and also because of the extent of the supervisory power exercised by the department over these local societies. This method consolidates the agricultural organizations into a single society in each county or district and empowers it to be the recipient of Government grants, and at the same time makes it subject to governmental supervision and control by the department of agriculture.

Instead, therefore, of being weakened by having many societies or a society for each specialty in agriculture, all subjects are included in one organization and recognized in the organization by classifying them and thus securing for each the interest and support of all of the members of the society, the farmers' institutes having the interest and help of the farmers' associations and the farmers' associations in turn having the aid of the institutes.

ONTARIO.

The farmers' institute movement in Ontario was organized by Dr. James Mills, president of the Ontario Agricultural College. The first meetings were held in January, 1885. The next year 26 meetings were held and the third year there were 40 institutes. In 1890 the Province was divided for institute purposes into seven districts, and to each institute meeting held in these districts three lecturers were sent—a professor from the agricultural college, a leading farmer, and a leading fruit grower. In 1894 the work had reached such proportions as to require the entire time of a superintendent.

The movement has steadily grown until the number of meetings reported by the superintendent for the year ended June 30, 1904, had reached 833, consisting of 1,623 sessions and having a total attendance of 106,719 persons. The membership for the first six months of 1904 was 20,957. Thirty-eight lecturers were in the employ of the provincial superintendent last year, who spent from two to ten weeks in the work.

One of the special features of the farmers' institutes in Ontario is the women's institute. In 1899 the superintendent of institutes addressed a letter to the women of the Province, asking their cooperation in the formation of women's institutes. The response was such that 20 organizations were formed the first year, and in May, 1902, the number had reached 44, with a membership of 2,816. The movement had now become an assured success and was regarded as entitled to the same recognition and support by the Government as the regular institute. Accordingly, in 1902, Parliament passed the following amendment to the original farmers' institute act:

> The formation of women's institutes for the purpose of improving rural home life and imparting information in regard to woman's work upon the farm shall be permitted under this act. The lieutenant-governor in council may, upon the recommendation of the minister of agriculture, adopt rules and regulations in regard to the organization of women's institutes, the general guidance or direction of such institutions, their relation to the farmers' institutes and the department of agriculture, and the grants of money to which they shall be entitled, with the conditions for payment of the same.

The result has been remarkable. The superintendent of institutes for the Province states under date of September, 1904:

> At present we have organizations in 57 electoral districts, and each of these districts has from 1 to 8 branches, making a total of about 200 places where regular monthly or bimonthly meetings are held. During the past year 960 meetings were held, at which 1,848 papers and addresses were given. The total attendance was 44,698.

The institutes in this Province had the advantage of having been organized by a leading educator in agriculture and in having had in their development the active support of the faculty of the agricultural college at Guelph and the provincial department of agriculture, whose members devoted a large amount of their time to giving instruction in institute meetings.

Much of the success of the work has been due to the wisdom displayed in the construction of the system under which the institutes are organized and to the choice of officers to take control of the work.

That the system has operated remarkably well is evidenced by the interest and success that has distinguished the work from the beginning. Through the instrumentality of the institutes 40,000 persons visited the agricultural college at Guelph in the month of June, 1903. These visitors were mostly farmers and their families, who took a day to go to the college and see the work that is being done in their interest on the experiment farm and to become acquainted with the president and members of the college faculty of instructors.

The work of the institutes has extended so as to include the improvement of the local fairs with a view to making them more highly educational and directly useful.

The methods pursued in carrying on the institute work are fully outlined in the accompanying act of the provincial Parliament providing for their organization.

Farmers' Institutes of Ontario, 1899.

In the construction of the farmers' institutes act and of the rules—

(1) "The department" shall mean the department of agriculture of the Province of Ontario.

(2) "The minister" shall mean the minister of agriculture of the Province of Ontario.

(3) "The superintendent" shall mean the superintendent of farmers' institutes for the Province of Ontario.

(4) "District" shall mean a district composed of municipalities as set forth in Schedule A [a] of the act, rules, and regulations.

(5) "Regular meetings" are those at which delegates sent by the superintendent are present and whose expenses, etc., are paid by the department.

(6) "Supplementary meetings" are those conducted by the local officers.

(7) "Regular delegates" are those sent annually to assist local officers to hold regular meetings.

(8) "Supplementary speakers" are those sent at the request of local officers to assist said officers when holding supplementary meetings.

FARMERS' INSTITUTE ACT.

Sec. 46. The formation of farmers' institutes for the purpose of disseminating information in regard to agriculture shall be permitted under this act, one for each district as given in Schedule "A" [a] to this act, but the lieutenant-governor in council may, upon the recommendation of the minister, authorize the organization of additional farmers' institutes or make changes in the limits of the various districts, so far as farmers' institutes are concerned, in order to increase their efficiency.

Sec. 47. The lieutenant-governor in council may, upon recommendation of the minister, adopt rules or regulations for the general guidance or direction of such farmers' institutes.

Sec. 48. Every farmers' institute shall be entitled to receive such money out of the unappropriated funds in the hands of the provincial treasurer as the legislature may grant; provided—

(*a*) That the number of members is at least 50, each paying an annual fee of not less than 25 cents.

(*b*) That the rules or regulations approved by the lieutenant-governor in council have been carefully observed.

(*c*) That all reports or returns required to be made to the superintendent have been made to the satisfaction of the minister.

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[a] Schedule omitted from this publication.

AMENDMENTS PASSED IN 1902.

Section 46 of the said act is amended by adding the following:

(*a*) The formation of women's institutes for the purpose of improving rural home life and imparting information in regard to women's work upon the farm shall be permitted under this act.

Section 47 of the said act is amended by adding the following:

(*a*) The lieutenant-governor in council may, upon the recommendation of the minister, adopt rules and regulations in regard to the organization of women's institutes, the general guidance or direction of such institutes, their relation to the farmers' institutes and the department of agriculture, and the grants of money to which they shall be entitled, with the conditions for payment of the same.

RULES AND REGULATIONS.

[Approved by the lieutenant-governor in council.]

1. The Ontario legislature has voted an appropriation for farmers' institutes for a grant of $25 to one institute in each district, on condition that an equal sum be granted by the county council or the municipalities in which the institute is organized, and on such further conditions as may be imposed by regulations of the minister of agriculture.

2. The object of each local institute shall be the dissemination of agricultural knowledge in its district and the development of local talent. The officers shall endeavor to bring the rank and file of the farmers into touch with the most successful local men, that the masses may become more conversant with the best and most profitable methods of farming, stock raising, dairying, fruit culture, and all branches of business connected with the industry of agriculture.

ORGANIZATION OF INSTITUTES.

3. One institute may be organized in each district of the Province, exclusive of cities, or in such other divisions as the lieutenant-governor in council may authorize.

4. The organization meeting may be called by the superintendent of farmers' institutes, by the head of a municipality, or by any five farmers of the district; and at least two weeks' previous notice shall be given by advertisement in two newspapers published in the district, or by placard, in which shall be stated the object, time, and place of meeting.

5. As soon as organization is completed the superintendent shall be notified, and the names and addresses of the officers and directors shall be forwarded to him.

6. All memberships shall terminate the 31st of December of each year. (See clause 57.)

7. Each institute shall be known by a distinctive name.

OFFICERS.

8. The officers shall consist of a president, a vice-president, and a secretary-treasurer, and one or more directors from each municipality included in the institute district, except in new or thinly settled districts, when directors may be elected irrespective of the municipalities. The president, vice-president, and directors shall be elected annually, and, together with the secretary-treasurer,

shall constitute a board of directors, the majority of whom shall be practical farmers.

9. There shall be an executive committee composed of the president, the vice-president, and the secretary-treasurer.

10. There shall be elected annually two auditors to audit the accounts of the institute.

11. If the secretary-treasurer resigns, or for any cause does not perform the duties of his office, or if he remove from the district, the president shall immediately issue a letter calling the officers and directors together, giving each at least ten days' notice. In the meantime the president shall perform the duties of the secretary-treasurer. At the time and place appointed the officers and directors present shall appoint a secretary-treasurer. In case the presidency is vacant, or the president does not take action within ten days, the vice-president shall assume the power of president. Other vacancies shall be filled in like manner.

12. Any change in the personnel of the executive committee or directorate shall be reported to the superintendent forthwith.

Annual Meeting.

DATE AND PLACE OF HOLDING.

13. The institute year shall begin June 1 and end May 31.

14. The annual meeting of each institute shall be held on some date to be selected between the 1st and 20th of June of each and every year. (See clauses 16, 17, 18, and 19.)

15. The newly elected board of directors shall take office at the close of the annual meeting. The old board shall remain in office until this time.

16. Each year a meeting of the directors shall be called by the secretary to meet some time before the 1st of March. The special business of this meeting shall be to arrange for holding the annual meeting.

17. If it is thought desirable by the directors present at this meeting that a delegate or speaker be in attendance at the annual meeting, the same may be arranged for through the superintendent, in which case the local institute shall pay the actual traveling expenses of the delegate or speaker from the time he or she leaves home until he or she returns thereto. (See clause 34.)

18. If it is decided that a request be sent to the superintendent for a speaker to attend the annual meeting, the directors shall, in addition, select the place for holding above meeting, the date being selected by the superintendent, as in the case of winter meetings. If, however, it is decided *not* to ask for a speaker through the superintendent, the directors shall select both date and place for holding annual meeting, conforming with clause 14.

19. A full report of this directors' meeting shall be forwarded by the secretary to the superintendent on or before the 1st of March.

Business at Annual Meeting.

20. At the annual meeting the directors and auditors shall be elected for the ensuing year. (See clauses 8 and 10.)

21. At the annual meeting the method of election shall be by ballot or otherwise, as decided by the members present. No person shall be eligible for office or be entitled to vote at the annual or any other meeting who has not paid his fees in full for the current membership year. (See clause 6.)

22. At the annual meeting members may suggest points in the district where institute meetings may be held during the succeeding institute year, first as to regular and secondly as to supplementary meetings.

23. At the annual meeting the executive officers for the past institute year shall, through the secretary-treasurer, present to the meeting, in writing, a carefully prepared report of the proceedings of the year, in which shall be stated the number of institute meetings held since the last annual report, the attendance at each session, the total number of papers read and addresses delivered, and a statement of the financial condition of the institute. The financial statement shall first be audited and certified thereto by the auditors.

24. The annual meeting shall be devoted to the business of the institute, as specified in clauses 20, 21, 22, and 23, and in carrying out the "programme of the annual meeting," and in considering ways and means whereby the institute can be improved.

25. The annual meeting shall be advertised by mailing to each member, at least ten days before the date thereof, an announcement calling the members together. Said announcement shall specify the date, place, and hour of meeting, and shall contain a programme of said meeting. If the executive deem it in the interest of the institute, posters and newspaper advertising may also be employed to make this meeting publicly known.

Order of Business for Annual Meeting.

26. (1) President's report.

(2) Discussion thereon.

(3) Report of the executive committee, presented in writing by the secretary-treasurer.

(4) Auditors' report, presented in writing.

(5) Suggestion of points at which to hold regular meetings.

(6) Suggestion of points at which to hold supplementary meetings.

(7) Election of directors; election of auditors.

(8) Suggestions as to how the institute can be improved or made more useful, if this has not already been considered by the president in his opening address or the discussion following.

(9) Addresses, etc.

27. At the close of the annual meeting the new board of directors shall meet and elect from among themselves a president and a vice-president, and shall finally decide at what points in the district regular and supplementary meetings shall be held during the current institute year. The points selected shall be entered on page C of the secretary's minute book, and a copy of this page shall be sent to the superintendent and shall be considered as part of the report of the annual meeting.

28. The board of directors shall, at the close of the first annual meeting, and when afterwards necessary, appoint from among themselves or otherwise a secretary-treasurer, who shall remain in office during pleasure.

29. In case an institute shall, through any cause, fail to hold its annual meeting within the time specified, the superintendent may appoint a date for holding same, the meeting to be called as provided for the regular annual meeting, and this meeting shall, in all particulars, be taken as the annual meeting of the institute.

Other General Meetings.

30. In addition to the annual meeting, each institute shall hold at least four meetings each year, at which papers shall be read or addresses delivered on topics relating to agriculture, horticulture, dairying, or kindred subjects. Free discussion shall be encouraged. (See explanation, p. 61, clause B.)

31. All institutes organized under the act shall be strictly nonpartisan and nonsectarian in every phase of their work, and no institute shall be operated

in the interest of any party, sect, or society, but for the equal good of all citizens and the farming community.

32. No subject shall be presented at an institute meeting or discussion allowed of a political or sectarian nature; nor shall any speaker be allowed in his lecture, essay, or speech, or in any discussion, to advertise wares or schemes in which he has a direct or indirect pecuniary interest. The delegates and officers of the institute shall see that the exercises are not subordinated to any low or frivolous entertainments or to the aggrandizement of any individual, party, or sect.

33. The regular delegation shall visit two points only in one year in each institute district, or when said delegation spends two days at one place that point only shall be visited. The government will defray the cost of sending these delegates, but officers and members of institutes are expected to lighten as far as possible the expenses of delegates while in their district.

34. Should any institute require a speaker or speakers at any other period during the year to assist in holding supplementary meetings, application for assistance shall be made to the superintendent at the time of reporting the annual meeting. The department will pay for the services of such supplementary speaker or speakers for four days in each year for each institute district, but the institute requiring the services of said speaker or speakers shall pay all legitimate expenses from the time said person or persons leave home until they return thereto. When a delegate or delegates address meetings in more than one district the expenses will be equitably divided between said institutes and collected from the institute or deducted from their grant.

35. If an institute decides to hold supplementary meetings other than those asked for at the time of reporting the annual meeting, or for more than four days during one year, said institute shall pay all expenses and wages. This clause shall not apply to the annual meeting.

36. If a regular or supplementary meeting has been granted and the time and place published in the annual bulletin, no change shall be made in said time or place. Any institute failing to hold a supplementary meeting published as aforesaid shall be required to pay the expenses notwithstanding.

37. All requests for assistance to hold agricultural, horticultural, live-stock, or dairy meetings shall be made through the secretary of the district institute. Applicants should state what subjects they wish the speaker to discuss.

38. Every meeting of an institute, except the annual meeting, should be advertised by issuing posters, not less in size than 15 by 20 inches, on which should be printed an attractive programme of the meeting, giving date and place of meeting, hour of opening, the name and address of the speakers, topics to be discussed by each; also the hour at which each speaker will address the meeting and the time to be occupied by each address; also the time allowed for discussion after each address, and such other information as the executive committee deems necessary. A copy of said bill should be sent at least two weeks previous to the date of meeting to each postmaster, each schoolmaster, each miller, each blacksmith, and to other places of public resort in the district which are within a radius of 10 miles of the place of meeting, with a request to post in a conspicuous place. It shall be the duty of the officers and directors to exercise diligence to insure the proper posting of said bills. In addition thereto, a programme of convenient size, containing similar information, should be distributed so as to reach its destination at least ten days previous to date of meeting. A copy of said programme should be sent to each member of the institute, to farmers, journalists, public men, and others in the district who reside within 10 miles of the place of meeting. Such posters and programmes should announce that all

interested are welcome, whether members of the institute or not. Copies of said programmes should be sent to the school-teachers in the district, with the request that they be carefully distributed among the children.

39. A copy of each poster and each programme shall be sent, as soon as published, to the superintendent and to each speaker advertised.

40. When institutes are notified of the dates assigned for their meetings, and are furnished with the names of the speakers and a list of topics, the executive committee should proceed to complete arrangements according to these rules. They should finally engage the hall, select local talent, etc. At least half of the time of each meeting should be occupied by local talent. The hall or other building to be used for holding the institute meetings should be lighted and heated, when such is necessary, at least half an hour before the time advertised. When light and heat are not required, said places should be opened and prepared for holding the meeting at least one-half hour before the time advertised.

41. The time allowed speakers should be from five to thirty minutes, to vary according to the subject and the ability of the speaker. It is no breach of courtesy to limit each speaker to the time allotted him in the programme. When the programme has been carefully prepared on that basis, no speaker should be allowed to exceed the time, to the embarrassment or detriment of the speakers who are to follow him. If speakers are held down to their time the work of the institutes, as a rule, will be benefited. Sessions should not be too long.

42. No one should be named on a programme who has not agreed to do the specific thing he is advertised to do.

43. At each meeting of the institute a committee should be appointed to canvass the audience for members.

BOARD OF DIRECTORS.

44. The board of directors, under these rules and regulations, shall have full control of the affairs of the institute. They shall arrange time and places of meetings, when not otherwise arranged for, and shall outline the work and policy of the institute.

45. The directors of each local institute shall convene each year in the month of February for the purpose of arranging for the annual meeting. At this meeting the order of business shall be as follows:

(1) Selection of a place for holding the annual meeting.

(2) Shall a request be sent to the superintendent for a delegate to attend the annual meeting?

(3) If it is decided not to send a request to the superintendent for the services of a delegate, the directors shall select a date on which to hold the annual meeting, which shall be between the 1st and 20th of June. (See clauses 14, 16, 17, and 18.)

EXECUTIVE COMMITTEE.

46. The executive committee shall carry into effect the plan of work decided upon by the board of directors and shall arrange the details of the same. (See clauses 9 and 66.)

NOTICE OF MEETINGS.

47. A meeting of the directors or of the executive committee may be held at any time, provided one week's notice by letter be given to each director, in the case of a directors' meeting, and a similar notice to each executive officer in case of an executive committee meeting. Meetings of the executive officers or of the directors may be held on shorter notice, provided each director or executive officer be otherwise notified and agrees thereto. (See clause 25.)

DUTIES OF OFFICERS.

PRESIDENT.

48. It shall be the duty of the president to preside at all meetings of the board of directors and of the executive committee. In the absence of the president the vice-president shall preside, and if both are absent a chairman shall be appointed by the committee.

SECRETARY-TREASURER.

49. The secretary-treasurer shall have the powers of a managing director, acting under the control and with the approval of the executive committee.

SECRETARY.

50. It shall be the duty of the secretary to call meetings of the executive committee and board of directors upon the authority of the president or any two officers or directors; to give notice of all meetings as required by these rules, and keep correct minutes of the proceedings.

51. All official correspondence relating to the institute shall be conducted by the secretary or in the name of the secretary.

52. In all correspondence relating to the institute the name of the institute shall be given in full after the signature of the officer, except in cases where an official heading is used giving the name of the institute.

53 All reports and returns required by the superintendent shall be made upon forms especially provided and in the manner indicated.

54. The secretary shall keep a book in which shall be entered the names and addresses of members in alphabetical order, also a book to be used as a mailing list, which shall contain the names of parties to whom posters, programmes, etc., may be sent.

55. It shall be the duty of the secretary to prepare and submit to the executive committee the annual report as set forth in clause 3, and to present the final report to the annual meeting.

56. Not later than the 1st day of July of each and every year he shall forward to the superintendent, by registered mail or otherwise, copy of said report, together with a copy of the financial statement and the name and address of each officer and director elected for the ensuing institute year.

57. On or before the 10th day of January of each year the secretary shall send a revised list of members for the current membership year to the superintendent, and on or before the 10th day of each succeeding month he shall forward the name and address of each additional person who has since the previous return become a member of the institute. (See clause 6.)

58. Within one week after the close of each institute meeting or series of meetings the secretary shall forward to the superintendent a detailed report of said meeting or meetings, in which shall be stated the name of the place or places where sessions were held, the number of persons present at each session, the name and address of each person who read a paper or gave an address, the title of the address or paper, and a comment upon its value, whether good, fair, or indifferent. (Use Form A of secretary's minute book for making returns required by this clause.)

59. On or before the 1st day of March the secretary shall report to the superintendent—

(1) The name of place selected for holding the annual meeting; also the name of the hall in which it will be held.

(2) The decision of the directors as to whether or not they wish the superintendent to arrange that a speaker address their annual meeting.

(3) The date chosen for holding the annual meeting if section 2 is decided in the negative.

60. The secretary shall, when possible, retain the manuscript of all papers read at meetings of the institute by local talent, in order that he may, when required, furnish the superintendent with the same. Each institute is required to forward at least two such papers each year, which may be published as the superintendent decides. Secretaries or essayists are not required to rewrite papers before sending them to the superintendent; forward them as read at local meetings.

61. All reports, names, post-office addresses, etc., should be written in a plain, legible hand, or they may be typewritten.

TREASURER.

62. It shall be the duty of the treasurer to receive and account for all moneys belonging to the institute, and disburse the same under the instructions of the executive committee, without whose order no money shall be paid out. He shall also prepare in detail and present to the annual meeting a duly audited statement of receipts and expenditures.

63. He shall use such cash and receipt books, membership tickets, etc., as may be required by the superintendent.

64. The funds of the institute as received by the treasurer shall, when possible, be deposited in a chartered bank to the credit of the institute.

DIRECTORS.

65. Each municipality in the district shall be divided annually between the directors representing the same, whose duty it shall be to make a thorough canvass for members each year. This division of territory shall be arranged at a directors' meeting held immediately after the close of the annual meeting.

66. As soon as it is decided to hold an institute meeting in a municipality, the directors elected to represent that municipality shall form part of the executive committee until after the close of said meeting. The duties of the said directors shall be to assist to the best of their ability the other members of the executive committee, to the end that a successful meeting may be held in their municipality.

67. It shall be the duty of the officers and directors to be present at the meetings of the institute. An officer or director who has not during the current year attended the meetings held in his municipality (except when prevented by sickness), or otherwise rendered valuable assistance to the institute, shall not be eligible for reelection to office for the ensuing year.

68. Every officer and director shall promptly answer all official communications addressed to him by the superintendent, and should make diligent efforts to furnish any information required of him relative to the affairs of the institute.

69. The officers and directors shall act as far as practicable upon the recommendations of the superintendent, and shall submit to him, through the secretary, all questions relating to the welfare of the institute upon which advice may be required.

Expenditure of Institute Funds.

70. All moneys received, whether as members' fees, legislative grant, grant from the county councils or from municipalities, or otherwise, shall be spent within the district in which the institute operates: (1) To defray actual expenses of

meetings such as are heretofore described; (2) to employ suitable persons to address said meetings; (3) to assist in circulating agricultural, horticultural, live-stock, and dairy literature or periodicals among the members, or to establish a circulating agricultural library for the use of members; (4) to remunerate the secretary and others for services rendered; (5) to make an annual grant (not exceeding $10) to the women's institute in the district.

QUORUM.

71. At all meetings of the institute or of the officers, if duly advertised as set forth in these rules, 10 members shall form a quorum to do business at an annual or other general meeting. At a directors' meeting five shall be a quorum. At an executive committee meeting two shall be a quorum. If at any meeting a quorum is not present, those present shall adjourn and the meeting shall again be called as prescribed by these rules. (See clauses 25 and 47.)

GENERAL RULES.

72. Each member of an institute shall be entitled to receive a copy of such publications as the following, issued by the department of agriculture for the Province of Ontario:

Report of the Ontario Agricultural College and Experimental Farm.
Report of the Ontario Agricultural and Experimental Union.
Report of the Butter and Cheese Association of Eastern Ontario.
Report of the Butter and Cheese Association of Western Ontario.
Report of the superintendent of farmers' institutes.
Report of the Dominion cattle, sheep, and swine breeders' associations.
Report of the poultry associations, east and west.
Report of the good roads instructor.
Bulletins of the agricultural college and experimental farm.

Any change of address or any failure to receive the bulletins and reports issued by the agricultural department should be reported immediately to the superintendent.

The names of all officers and directors shall be included in the list of members.

73. The blank books used shall be those authorized by the department. Blank forms for reports of meetings, financial statements, and lists of members, membership books, mailing books, cashbooks, etc., may be had from the superintendent.

74. All institute returns shall be made to the superintendent.

ORDER OF MEETINGS.

75. (*a*) Except by permission of the presiding officer, no member or other person shall speak other than to ask a question or to introduce or speak to a motion.

(*b*) In the discussion following the introduction of a subject, no person shall speak more than twice nor for a longer time than five minutes, except by a vote of the meeting.

(*c*) When a question is under consideration, no motion shall be in order except the following: (1) To adjourn; (2) to postpone; (3) to amend—these motions taking precedence in the order named, and the first two shall be decided without debate.

(*d*) Before the vote is taken on any motion or amendment, the president shall ask: "Is the meeting ready for the question?" The question shall not be put so long as any member desires to speak and is in order. Any member desirous of asking a question on the subject introduced may do so verbally, but if he desires to ask more than two questions he must submit them to the secretary in writing.

76. Every member is entitled to the following privileges:

(*a*) To protest against any decision of the institute, and request his objection to be recorded in the minute book.

(*b*) To protest against the decision of the Chair and appeal to the meeting, stating the grounds of appeal, which shall then be put without debate in these words: "Shall the decision of the Chair be sustained?"

77. A motion to reconsider any question decided by the institute shall be in order, providing such a motion be not made on the same day on which the resolution is carried.

78. Order of business for general meetings other than the annual:

(1) Calling the meeting to order by the president.
(2) Reading and disposing of communications.
(3) Reports of committees.
(4) Programme of the day, and discussion.
(5) Question drawer.
(6) Adjournment.

Explanations.

A. In framing the act and rules special care has been taken to lessen rather than increase the work of the local secretaries.

B. (See clause 30.) The four meetings referred to in clause 30 may include the regular and supplementary meetings of the institute; picnics, if addresses on agricultural subjects are given, or if the point visited is one of agricultural interest, such as an experimental station, a noted farm, etc.; also official meetings called to meet the superintendent. A meeting continuing two days may be counted as two meetings. Each of the aforesaid meetings should be reported as set forth in clause 58.

Legislative Grants.

C. The reports of the annual meetings must be sent to the superintendent not later than July 1. As soon as these have been completed in satisfactory form, the superintendent will notify the minister of agriculture, and the legislative grants will be paid as soon as convenient. If all reports are made out and forwarded in accordance with these instructions, the officers will receive the grants about August 1, or within a few days thereafter.

QUEBEC.

The farmers' institute work in the Province of Quebec is organized in the form of incorporated farmers' clubs. The club has the power "to acquire and possess lands for holding exhibitions, for establishing agricultural schools or model farms, and may sell, lease, or otherwise dispose of the same, but can not own more than 200 acres of land at a time."

Any agricultural club may have "animals of improved breed, sold by auction or otherwise, without paying the duties required by law, provided the purchasers undertake to keep such animals within the territorial district of the club during such time and upon such conditions as the club may determine."

The clubs are empowered to "promote and favor experiments in farming, manuring, and improved agricultural machinery and implements; encourage the study of the best methods of fattening cattle, the production of milk or manufacture of butter or cheese, and the improving and draining of lands."

The funds the clubs derive from subscription of its members and from public grants are not allowed to be expended for refreshments, visits, entertainments, or anything similar thereto.

FORMATION OF CLUBS.

The statutes provide that—

(1) One or more farmers' clubs may be formed in any territorial division erected for the purpose of establishing agricultural societies, and such clubs shall enjoy all of the advantages and privileges of such societies.

(2) There can not be more than one club in any parish whatever may be the number of municipalities in such parish, nor more than one club in either municipality or township.

(3) The club must have at least 25 members who have subscribed the total amount of $30 and who signed the following agreement and transmitted the same to the minister of agriculture:

"We, whose names are subscribed hereto, agree to form ourselves into a club, under the provisions of the law respecting agriculture and colonization, to be called the ——— Farmers' Club (of the parish or municipality, as the case may be) of ———; and we hereby and severally agree to pay to the treasurer yearly while we continue members of the club the sums set opposite our respective names, and we further agree to conform to the rules and by-laws of the said club."

If the minister of agriculture deems it expedient to authorize the formation of the club, he immediately causes a notice of its formation to be published in the Quebec Official Gazette.

(4) The club is composed of the persons who have signed such declaration as long as they continue to pay an annual subscription, and of all persons who in the future shall pay such annual subscription.

(5) The amount of the annual subscription to become a member of the club is fixed at $1, but members may subscribe more if they wish so to do.

(6) If more than $2 is paid by any one member, the board of managers is authorized to give him seed and fertilizers, or any other thing calculated to aid in his farming operations, to an amount equal to the additional sum paid by him.

MEETINGS OF CLUBS AND ELECTIONS OF DIRECTORS.

1675*n*. An annual general meeting of the members of every club shall be held on the second Wednesday in December in each year, and, in the territorial districts where there is no club, a meeting for the formation of a club may be held on the same date.

1675*o*. Such meeting shall be convened by notice posted up or read at the church doors, or at any other public place in the territorial district of the organized or projected club, at least eight days before such meeting, by order of the president of the club or, in his absence, of the vice-president of the society; and in districts where no club has yet been organized the same shall be done by order of the mayor or a councilor of a municipality, and the person who shall have called the said meeting shall be entitled to preside at the said meeting until a president is elected.

1675*p*. At such meeting the club elects seven directors, who must be chosen from amongst the members of the club.

1675*q*. At its first meeting after the annual general meeting, or on the day of the annual meeting, if all the directors are present, the board of directors elects a president and a vice-president from amongst the directors, and a secretary-treasurer, who must be taken from outside of the board of directors, and who, after his election, does not form part of such board.

1675*r*. The meeting for the formation of a club or the election of directors of a newly organized club, may be held at any time after notice published in the manner indicated in article 1675*o*; but no club is entitled to any share of the grant for the year during which it was organized unless the organization and election of directors have taken place before the 1st of May of such year.

1675*s*. The officers and directors of each club shall, during the year immediately following the annual meeting, and until the election of their successors, exercise all the powers conferred on the club by this section.

In case of vacancies during the year among the officers or directors, such vacancies shall be filled up by the board of directors.

1675*t*. They shall hold their meetings according to the terms of the adjournment or to a notification in writing, forwarded to each of them by order of the president, or, in his absence, by order of the vice-president, or of the president pro tempore, three days at least before the day fixed for the holding of such meeting.

1675*u*. At any meeting four shall form a quorum.

1675*v*. The officers and directors shall have full power, at every meeting, to make regulations and by-laws for the government of the club and to modify and repeal the same: *Provided always*, That such regulations and by-laws be consistent with those published by the council of agriculture and be submitted in every case for the approval of the minister of agriculture.

1675*w*. The directors shall, whenever the minister of agriculture deems expedient, convene a general meeting of the members of such club, at which lectures on agriculture shall be given.

The public shall be admitted to such lectures.

In default of holding such meetings when required by the minister of agriculture, the provincial grant may be taken away.

During the fifteen days following such meeting the president and secretary shall sign and transmit to the minister of agriculture a report setting forth the date of the meeting, the name of the lecturer or lecturers, the subjects dealt with, and the approximate number of persons present.

1675*x*. The directors shall draw up and submit, at the annual meeting, a detailed report of their operations during the year that is about to end, declaring and showing the names of all the members of the club, the amount subscribed and paid by each of them, the names of all persons to whom prizes shall have been awarded, the amount of each such prize, and the name of the article or head of cattle for which the prize was awarded, the number and date of the general meetings, the name of the lecturer or lecturers, the subjects treated and the approximate number of persons present, together with such other remarks on the agriculture of the county and the improvements which either have been or may be introduced into the same, as the board of directors is in a position to offer.

1675*y*. They shall further submit at the said meeting a detailed statement of the receipts and expenditures of the club during the year.

1675*z*. The said report and statement, when approved by the meeting, shall be entered in the journal of the club kept for such purpose, which entry shall be signed by the president or vice-president, as faithful and correct, and a copy thereof, attested by the president, vice-president, or secretary, for the time being, shall be transmitted to the minister on or before the 1st day of January following.

Each club is entitled to an annual grant of 50 cents per member, taken from the sum appropriated to the payment of grants to agricultural societies, and every member is further entitled to receive the Journal of Agriculture and Horticulture, notwithstanding no club shall receive in any year less than $25 nor more than $50 in addition to the Journal of Agriculture and Horticulture, and no grant can be given to a club unless $30 have been subscribed and paid to its treasurer by at least 25 members.

1675*ll*. The grant shall be due and payable to each club so soon as the report, statement of accounts, and scheme of operations thereof shall have received the approval of the minister, and so soon as the president and secretary-treasurer or any other officer of the club shall have transmitted to the minister an affidavit, in the form of Schedule F[a] of this section, sworn to before a justice of the peace, setting forth the members then forming part of the club whose subscriptions for the current year have been paid into and are in the hands of the treasurer.

The said affidavit shall be sent by registered letter to the department of agriculture on or before the 1st of September in each year. If it be not transmitted at such date or within the thirty days following the grant for that year may be suppressed; but it shall be the duty of the secretary of the council of agriculture to give notice on the 1st day of July in each year to all clubs, by a registered letter addressed to the secretary-treasurer of each such club, that its grant for the year will not be allowed if the affidavit required by this article has not been transmitted by registered letter to the said department, as by law required.

1675*qq*. If a club neglects for two years to comply with the requirements of the present section the minister may declare it dissolved, realize its property, and employ the proceeds in paying the debts of such club, and use the surplus of the assets over the liabilities for encouraging agricultural institutions and for promoting the general interests of agriculture in the county in which such club existed.

1675*bbb*. After an existence of five years such society may at any time be dissolved by the minister upon petition of the majority of the clubs composing the same.

The minister may, if he orders the dissolution, take possession of the property of the dissolved society, realize it, pay the debts, as well out of the proceeds of its property as out of the grants to the clubs of the county, and if there is any surplus may distribute it among the agricultural institutions of the same county or territorial division.

1675*ccc*. Every club forming part of a society and not having the amount of subscriptions and the number of members required by law may, however, continue to exist and to receive its grant, provided it has at least 15 members and $15 of subscriptions.

1675*ddd*. All the provisions of the revised statutes respecting clubs and agricultural societies apply to clubs' societies and to the clubs composing them, in so far as they are not inconsistent with this section.

The deputy minister of agriculture for the Province, who has direction of the institute work, reports that over 600 farmers' clubs were in operation in the Province in 1902, of which number 555 complied with all of the conditions imposed by the law, and received altogether $22,427.50 from the government grant.

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[a] Schedule omitted from this publication.

The institute lecture force consists of two permanent lecturers appointed by the provincial government, assisted by specialists and good practical farmers. Lectures are also given by experts sent in by the Dominion government. The institute meetings are not confined to any particular season of the year, but may be held at any time convenient for the farmers of the locality.

The number of members in 1902 was 48,294, and to each of these the Journal of Agriculture and Horticulture was sent gratuitously twice a month. The superintendent states also: "We consider farmers' clubs to be more effective as they are organized than if they were mere institutes. The lectures and the increased circulation of the Journal of Agriculture, as well as the purchase of improved live stock, has greatly contributed to the improvement of agriculture in the Province." Most of these clubs own standard breeds of stock, and in 1902 they bought high-bred animals to the value of $11,239.37.

Extracts from By-Laws.

Article 53*a*. Article 53 of the by-laws of the council of agriculture is applicable to the farmers' clubs in fixing the total value of the distribution at an amount which shall not exceed the subscription of each member, except in altogether special cases, of which the council shall be the judge.

Article 53*b*. In the case where clubs should consider it advantageous to hold a competition for the best-kept farms, such clubs shall be obliged to offer not less than five prizes, viz: First prize, $5; second prize, $4; third prize, $3; fourth prize, $2; fifth prize, $1. Each club may, nevertheless, offer prizes of a greater value. These prizes shall only be paid in books treating of agriculture, in improved agricultural implements, in seeds, or high-class breeding stock, as the directors may decide.

Article 53*c*. Every member of a club who shall have paid his subscription of $1 and an additional special entry of 25 cents before the 1st of May shall have the right to compete in the competitions for the best-kept farms.

Article 92. No competitor shall be entitled to more than one prize in the same class, and no animal can compete in more than one class except for prizes offered for the best herds.

Article 121*a*. Agricultural societies and clubs have the power in competitions for the best-kept farms to admit or to refuse to admit to the next competition the person who carried off the first prize at the last competition, as they may consider it most advantageous to their respective associations.

GREAT BRITAIN.

The movement in aid of agriculture in Great Britain culminated in 1887 in the appointment by Parliament of a departmental commission, for the purpose of "inquiring into and reporting upon agricultural and dairy schools in Great Britain, which may appropriately receive Government grants, and to advise as to the department which should be charged with the administration of such grants."

In an elaborate report dated December 9, 1887, and in a subsequent final report, under date of February 27, 1888, the commission outlined a system of agricultural instruction which was substantially adopted by Parliament the same year. The report recommended the extending of Government aid to certain institutions, charging them with the duty of providing instruction in agriculture, the distribution of the parliamentary grants to be in the hands of a board of agriculture, to be created for this purpose.

The plan contemplated the establishing of a collegiate center in each of the five produce districts of England, and with two additional for Scotland. The produce districts referred to were each made up of a number of counties which the agricultural department treat as a unit in making estimates of crops.

The first annual grant was £5,000, and was appropriated in 1888. It was made the duty of the college receiving aid from the Government grant to provide not only for giving instruction in agriculture indoors, but to extend its work through the particular produce district or area of which it was the recognized educational center.

MIGRATORY SCHOOLS.

In providing agricultural instruction for the outlying counties, "migratory schools" under the direction of the collegiate centers were organized. The conditions under which these schools are operated vary somewhat in the different districts. The report of the inspector appointed to visit and report upon the work of the traveling schools in the Swindon district gives the details of the method that is pursued in establishing and conducting a traveling dairy school. The report states that—

> The society (Bath and West of England Society) with the assistance of a local committee organizes the school and provides teachers and necessary appliances. The local committee guarantees suitable premises free of charge, also as much milk and cream as may be required, together with the attendance of not less than ten students. The society gives, as a rule, two complete courses of instruction of ten days each, charging:
>
> | | £ | s. | d. |
> |---|---|---|---|
> | For the entire course of ten days or over | 1 | 1 | 0 |
> | For one week's instruction | | 15 | 0 |
> | For one day's instruction | | 5 | 0 |
>
> The manufactured produce is in all cases the property of the local committee.

During the year 1889 this society organized and conducted 8 such schools, aggregating one hundred and sixty days of instruction and attended by 218 students. Similar peripatetic schools were conducted during this period by the University College of North Wales, the Leicester Educational Committee, the Eastern Counties Dairy Institute, and the British Dairy Farmers' Institute.

As has been stated, the board of agriculture, in organizing the work of agricultural education for Great Britain, adopted the plan of grouping the counties, establishing an agricultural college or high school in each group, the work of agricultural education in each to be largely under the general direction of the central institution.

In 1890 an important modification of the work of providing for agricultural instruction was brought about through the passage of an excise act by Parliament, whereby the local authorities, known as county councils, were afforded large additional resources derived from local taxation, and were intrusted with discretionary power to use the funds thus supplied, in providing such forms of agricultural teaching as were embraced in the technical-instruction act of 1889. Until this time financial support for local agricultural institutions was from the Government grant, and the formation of the courses of study was in the hands of the central college established for the district. The legislation of 1890 rendered the counties independent of Government aid in carrying on their agricultural education work and enabled them to inaugurate a system of instruction of their own.

The sums thus placed at the disposal of the county councils are quite considerable. In 1901–2 the receipts from the excise tax, available for technical instruction in England and Wales, amounted to £708,517. Of this sum £88,893 were used directly in 1902–3 in aid of agricultural education. The distribution for that year was as follows:

General expenditures	£7, 223
Dairy instruction	12, 845
Agricultural lectures	5, 715
Poultry keeping	3, 284
Farriery and veterinary science	2, 542
Bee keeping	1, 380
Horticulture	10, 562
Manual processes	1, 511
Miscellaneous	4, 743
Scholarships	10, 800
Colleges and schools	28, 288
Total	88, 893

When the Government grant for agricultural education was first made and for two years thereafter the board of agriculture aided the county councils from this general grant, but when the act of 1890, making provision for agricultural educational work in the counties, became effective the funds belonging to the parliamentary grant were devoted exclusively to the aid of the colleges which had been established as centers of education in agriculture in the various districts.

and the counties were left to carry on their work from the proceeds of the excise fund.

For a time the county councils appropriated the entire excise fund to local purposes, but later they also assisted the agricultural colleges of their respective districts and aided as well a considerable number of secondary agricultural schools. In 1899–1900, the latest classified date given in the reports of the board of agriculture and fisheries, the assistance given to the agricultural colleges and schools in England and Wales by the county councils amounted to £25,616, and £8,256 additional was devoted to meeting the expenses of scholarships of students sent to agricultural colleges by the respective counties.

In that year the county councils of England and Wales contributed to the maintenance of 23 local secondary schools in which agriculture was taught, and to 37 collegiate centers. Ten of these collegiate centers had been established by Cambridge University, 5 by Reading College, 3 by Durham College, 4 by Nottingham University, 2 by Southeastern Agricultural College, 3 by Yorkshire College, 5 by the University of North Wales, and 5 by the University College of Wales.

It will thus be seen that the work of agricultural education in Great Britain is divided, part being intrusted to the colleges and schools of agriculture supported from the general grant by Parliament distributed by the board of agriculture and part placed under the control of county councils, who meet the expenses of their maintenance from the local tax or excise fund.

The county councils at first constructed courses of study in agriculture for these local schools independent of outside aid. Now, however, they are cooperating with the board of agriculture and are availing themselves of the assistance of the board in its advisory capacity respecting their educational purposes. The secretary of the board in his report for 1901, in discussing the cause that led to this cooperation, says:

> It is satisfactory to be able to report that county councils are evincing an increasing desire to avail themselves of the assistance of the board in its advisory capacity in the development of their educational schemes so far as these bear upon agriculture and rural science. The advice and guidance which the board have been thus able to give have resulted not only in the fuller utilization of existing machinery, but as well in the avoidance of duplication of local agencies. Without such central coordinating influence there is a tendency on the part of the local authorities to proceed without due regard to developments outside their own area, whereas joint action may often result in improved efficiency concurrently with greater economy.

When the traveling schools were introduced the policy was adopted of concentrating the instruction upon one subject. Dairying was accordingly selected, and all the strength of the teaching force was concentrated in that direction. Gradually the policy was widened to include bee keeping, farriery, poultry keeping, horticulture, gardening, and other branches of agriculture.

The details of the various methods pursued and scope of the work now being done by the county councils in promoting agricultural education can best be understood from the reports of the several inspectors of the board of agriculture, whose duty it is to visit the counties periodically and inspect their work. Reports from several of the counties are presented for purposes of comparison.

The following statement is by the inspector for the county of Bedford for 1899–1900:[a]

COUNTY OF BEDFORD.

The county provides a farm school at Ridgmont, near Woburn, for sons of small farmers and laborers, to whom instruction is given in agriculture, market gardening, bee keeping, and poultry keeping; a grant is also given to the agricultural department, Cambridge University. There is accommodation at the school for 20 students, all of whom must have been actually engaged on the land and must hold county scholarships which entitle them to two years' board and residence with instruction free. In 1899–1900 there were 14 resident scholars and 2 ex-scholars were retained to assist in the work of the farm.

Lectures are given throughout the county in horticulture and poultry keeping, while demonstrations and competitions are organized in various manual processes. Classes in general agriculture are also held in the villages.

Particulars of the work done in these subjects in 1899–1900 are furnished below:

Agriculture.—Classes were held at 26 centers during the winter, and 568 pupils received instruction, of whom 427 were farm lads, the teachers being drawn from the elementary schools.

Horticulture.—Practical gardening classes by the county staff instructor were held at 2 centers; lectures were given at 9 centers and at a reformatory school.

Poultry keeping.—Courses of lectures were given at 5 centers by the master of the farm school.

Manual processes.—Demonstrations and competitions were held in sheep-shearing, horseshoeing, plowing, hedging and ditching, and stacking and thatching.

Scholarships.—Seven agricultural scholarships, tenable at the Ridgmont Farm School, were awarded in 1899–1900. In addition, 10 scholarships were awarded to enable teachers to attend the three weeks' summer course at Cambridge.

COUNTY OF BERKSHIRE.

The county works in conjunction with the Reading College, to which it makes an annual grant of £200, together with an additional grant of £50 for field experiments.

Local classes were held in 1900 at a number of centers, in poultry keeping and horticulture. Particulars of these classes are given below.

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[a] It is proper to explain that the data presented in this statement of the educational system of Great Britain, as well as those respecting the systems in use in other countries, have been selected from such reports as seem to most satisfactorily exhibit the methods in use, although in some instances not the latest publications upon the subject.

Horticulture.—Courses of six lectures each on this subject were given. The last lecture of the series is usually on some such subject as "Soils and manures," and given by one of the staff of Reading College.

At one center a long course of 15 lectures was given, for which 25 pupils, gardeners, and allotment holders entered, 8 of whom afterwards sat for the Royal Horticultural Society's examination and received certificates. At one other center only 2 lectures were given.

Poultry keeping.—Ten courses of 4 lectures each, with an average attendance of 29, were held in different parts of the county, and 6 classes for practical instruction in poultry trussing were also held.

Bee keeping.—The technical education committee makes an annual grant of £50 to the Berks Beekeepers' Association. The county has been twice covered by the bee-van tours, and in 1900 the work was confined to a general tour of the county by experts, who gave practical advice when it was needed and collected statistics as to the progress made in bee keeping.

Manual processes of agriculture.—No provision has hitherto been made for this class of instruction in the county, but the technical education committee are prepared to give careful consideration to any application from a district for instruction of this character.

Scholarships.—Four agricultural and horticultural senior scholarships of £50 each, four agricultural exhibitions of £35 each, and ten dairy scholarships of £10 each were offered in 1899–1900. The agricultural scholarships are tenable at Reading College, the dairy scholarships are tenable at the British Dairy Institute, and those on horticulture are tenable at the horticultural college, Swanely. There were no candidates for the agricultural scholarships and exhibitions. One horticultural scholarship and seven dairy scholarships were awarded.

The agricultural exhibitions of £35 each were tenable at the Dauntsey Agricultural School, West Lavington, but it is in contemplation to replace these by four agricultural exhibitions of £30 each, tenable at Reading College for a six months' winter course. They will be open to candidates between the ages of 16 and 25, and are intended for those already familiar with the general routine of farm work who aim at becoming practical farmers.

Since 1893 16 senior scholarships in agriculture and 4 in horticulture have been awarded.

Experiments.—Manurial and other experiments were carried out at eight centers.

County of Cheshire.

There are in this county two principal centers maintained by the county council, viz, the Agricultural and Horticultural School at Holmes Chapel and the Dairy Institute at Worleston.

The Holmes Chapel School was opened in 1895. It provides a complete agricultural course lasting three years, a diploma or certificate being granted to successful students at the end of the course. The number of county council scholarships, which cover board and fees, held at this school in 1899–1900 was 29, and the total number of pupils in April, 1900, amounted to 45. Various experiments are carried out on the farm attached to the school, and nearly the whole area of the farm, which amounts to 100 acres, is now under experiments. The experimental work in 1899–1900 included the cultivation of potatoes, grain crops, roots, grasses, etc.; the spraying of charlock, and experiments in tuberculosis with the cattle at the Holmes Chapel and Worleston schools. For instruction in horticulture a garden of 7 acres, with greenhouses, is provided.

The Dairy Institute at Worleston was taken over by the county council in 1891. To it is attached a grass farm of 170 acres, maintaining a milking herd of nearly 60 cows. Resident accommodation is provided for 18 pupils. There were 57 pupils during the years 1899–1900, the average length of their stay being twelve and one-half weeks. Scholarships tenable at this school are granted by the technical instruction committee, usually for ten weeks, but this period will in future be extended to twelve weeks. The total of such scholarships (10s. a week) held in 1899 amounted to 36. There were also 18 domestic scholarships (£4 10s. each), which include instruction in butter making, held at the institute in 1899–1900.

Lectures are given in the county on general agriculture, dairying, horticulture, veterinary science, and bee keeping. Particulars of these for 1899–1900 are as follows:

Agriculture.—Two lecturers were employed by the technical instruction committee to give 10 lectures a week each. Classes in the principles of agriculture were held in secondary schools (average number in class 15) and similar instruction was also given in a few good elementary schools, where there was a sufficient number of boys of a suitable standard; 5 such schools were visited, the class averaging 33. Evening courses of 6 lectures were given at 13 centers (average attendance 23) and of 1 lecture at 6 centers (average attendance 34), and there were also special courses of two to three months or more at 3 centers.

Dairying.—This form of instruction is given at farmhouses where possible. Classes for both dairying and butter making lasting four days each were held at 7 centers, the average attendance of pupils being 9; classes for butter making only, lasting eight days, were held at 13 centers, the average attendance being 13. A butter-making competition, at which students who made 5 or more attendances were eligible to compete, was held in April. A dairy demonstration was also held at the Cheshire Agricultural Society's show at Northwich in August.

Horticulture.—Courses, usually of three lectures, were held at 8 centers (the average attendance was 44), and a special lecture on fruit growing was given to the members of the Nantwich Farmers' Club.

Veterinary science.—Courses of 3 lectures were given at 5 centers; the average attendance was 30.

Bee keeping.—Lectures were given at 8 centers.

Scholarships.—In 1899–1900 there were 29 agricultural and horticultural scholarships held at the Holmes Chapel School. These scholarships, which cover the expenses of board and fees, are granted for one year, but are renewable for a second and third year if the reports as to progress and conduct are satisfactory. At the Worleston Dairy Institute 36 dairy scholarships and 18 domestic scholarships were held. The former are for a ten weeks' course in dairy work, while the latter are for a nine weeks' course in butter making, bread baking, cookery, laundry work, dressmaking, needlework, and sick nursing.

Experiments.—Experiments were carried out under the direction of the staff of Holmes Chapel Agricultural School in the manuring of mangolds and swedes, in the cultivation of different varieties of grain and potatoes, in charlock spraying, and in seeding for grass. Separate reports, in pamphlet form, of the first four were prepared and circulated. Invitations were issued to agricultural bodies in the county to inspect the experimental plats at the farm, which were freely accepted. Lectures in connection with the experiments were given at 6 centers.

COUNTY OF CUMBERLAND.

Direct agricultural instruction is provided by the maintenance, in conjunction with Westmoreland, of a dairy farm and school at Newton Rigg, near Penrith, by a traveling dairy school and by migratory lecturers on various subjects. The

Newton Riggs School provides systematic and practical instruction in cheese and butter making, rearing of live stock, rearing and dressing of poultry, and general farm work. A cheese dairy has been recently added. There is accommodation for 10 resident pupils at a time. The course for male pupils lasts sixteen weeks and that for females for half this period.

The county scheme provides for two county agricultural scholarships of £50, tenable for two or three years, at the agricultural college, Aspatria, or any college in receipt of aid from the board of agriculture; one exhibition of £35 from the Newton Rigg School to a special course for farmers' sons at the Durham College of Science, and also for 20 farm studentships, of the value of £4 and £5 each, tenable for periods of from eight to sixteen weeks at the county dairy farm and school.

Field experiments are conducted by arrangement with the Durham College of Science under the direction of the professor of agriculture at that college.

The work performed during 1899–1900 was as follows:

Agriculture.—Lectures were given at 16 centers before an average audience of 25. Each lecture dealt with some particular subject, but calf rearing and turnip growing were most frequently selected.

Dairying.—Owing to a vacancy in the post of teacher, the traveling dairy van did not go out in the spring and summer, but an autumn course was held, when 5 centers were visited, with an attendance of 60 pupils.

Horticulture.—Lectures are delivered on this subject in every alternate month by the lecturer in horticulture at the Durham College of Science in virtue of an arrangement between the county councils of Cumberland and Northumberland with the authorities of the college; 75 centers were visited, and the attendance averaged 26, more hearers being generally attracted in the spring and summer than in the winter.

Poultry keeping.—One, two, or three lectures on poultry rearing and management were given at 29 centers, the attendance being 33 on the average.

Scholarships.—No major agricultural scholarships were awarded during the year, but nine studentships of £5 each, one of £4 10s., six of £4, and one of £3 were awarded at the Newton Rigg Farm School.

Experiments.—The field experiments were continued on much the same lines as before and have been noticed in connection with the work done by the Durham College of Science.

COUNTY OF ESSEX.

The technical education committee have established county technical laboratories at Chelmsford. In connection with these "schools" of horticulture and agriculture have been organized. Two courses in agriculture, each of three weeks' duration, are held in the autumn and winter at the laboratories, while there are three weeks' elementary courses in horticulture in the summer, autumn, and winter, as well as a more advanced course of four weeks in the spring. A garden has been acquired and is divided into four main divisions, viz, botanical, vegetable, fruit growing, and experimental.

Arrangements have also been made for the analysis, at the county laboratories, of fertilizers, feeding stuffs, soils, milk, butter, water, etc., and for the examination of seeds and diseases of plants, etc., for Essex farmers at moderate fees.

Ten days' courses of practical lessons in butter and soft cheese making are provided by a traveling dairy school, which visits various centers. These classes are limited in each case to 10 pupils, but visitors are admitted as spectators. Lectures are also given on the bacterial contaminations and on the chemistry of milk, and instruction is also provided in dressing and trussing poultry.

Field experiments are carried out at various centers throughout the county.

Arrangements are made for supplying farriery instruction at suitable centers.

Agricultural, horticultural, dairying, and poultry scholarships, tenable at various institutions, are awarded by the technical education committee. The county also contributes to the maintenance of the agricultural department of Cambridge University by means of an annual grant.

Particulars of the work carried out in 1899–1900 are as follows:

Central laboratories.—The two agricultural courses at the county laboratories, Chelmsford, were attended by 10 and 9 pupils, respectively; the three elementary horticultural courses were attended by an average of 11 pupils, and the advanced course of four weeks attracted 10 students.

Agriculture.—Courses of from 4 to 8 lectures were given on chemistry as applied to agriculture at 11 centers (average attendance, 20) and of 5 lectures on agricultural biology at 3 centers (average attendance, 15).

Dairying.—The traveling dairy school visited 9 centers; the number of pupils was 102, of whom 82 took the full course of nine days. Lectures on dairy bacteriology and the chemistry of milk were given at each class.

Horticulture.—Courses of 1 to 6, and in one case 10, lectures were given on horticulture at 41 centers (average attendance, 18).

Poultry rearing.—Lectures, usually 4 each, were given at 14 centers; the average attendance was 27.

Manual processes.—Instruction was given at 12 centers in plowing, sheep-shearing, hay binding, and farriery, a second class being held at one of them. The number of lessons varied from 5 to 12; the total number of students was 172.

Visit to Holland.—An excursion to Holland was organized by the technical education committee for Essex farmers with the object of studying agricultural education and the organization and practice of the agricultural industry in that country.

Local committees.—In addition to the above, classes and lectures were organized by local committees throughout the county, consisting of 5 on bee keeping, with 160 students; 6 on farriery, with 111 students, and 3 on live stock, with 52 students.

Scholarships.—Two horticultural scholarships of £45 each, tenable for two years at the Swanley Horticultural College or the Royal Horticultural Society's gardens, at Chiswick, were awarded in 1899–1900. Four dairy scholarships, tenable for five weeks at the British Dairy Institute, Reading, and five poultry scholarships for the three weeks' course at the Eastern Counties Dairy Institute, Ipswich, were also awarded.

Experiments.—Experiments were made on the treatment of rotation crops and permanent pasture, the residual value of manures, the prevention of clover sickness, etc., at 21 centers. Explanatory lectures were given, and an exhibition of specimens of the experimental crops was arranged at the agricultural show.

County of Kent.

The principal center for agricultural instruction in the county is the South-eastern Agricultural College, Wye, which is supported by the county in conjunction with Surrey. During the year 1899–1900 20 students from Kent attended the college, and, with one exception, were present throughout that period. In addition, the college undertakes to deliver a certain number of outside lectures in the county during the session and to provide instruction in farriery by means of a traveling van fully equipped with forges, tools, etc.

The county also makes use of the horticultural college at Swanley, offering each year 12 horticultural scholarships of £60 each, tenable at this institution for two years. Four were awarded in 1899–1900. Six students from Kent passed the Royal Horticultural Society's examination, and numerous successes were gained by the county scholars in the board of education's examinations in agriculture, botany, chemistry, and geology.

The remainder of the work done in the county is performed by the council directly.

Particulars of the lectures provided and work done in 1899–1900 are furnished below.

Horticulture.—Courses of six lectures were given at 60 centers. At 55 of these centers competitions were held, limited to scholars who had attended at least 4 out of the 6 lectures, and prizes were awarded to the successful candidates. Boys' gardens are maintained at 20 centers. The gardens are divided into plats of about 1 square rod each, and they are cultivated by boys admitted as pupils, each boy having a separate plat. The number of boys admitted at each center is 15. The plats are under the supervision of a local instructor specially appointed by the committee, the county superintendent making an inspection three times annually, when prizes are awarded to the most meritorious cultivators.

Thirty lectures on garden science were delivered at 10 centers in the county by lecturers from the Southeastern Agricultural College.

Poultry keeping.—Courses of 4 lectures were provided at 25 centers. Prizes were offered for competition among the students, and the first annual competition was held at a county show.

Bee keeping.—In this subject a pioneer lecture is given in February at each center which it is intended to visit, and is followed in the summer by demonstrations in practical management by means of an experimental apiary set up at some point in the parish. Visits were made to 12 centers during the season, the classes averaging 10 pupils. The instruction was succeeded by apiary competitions in five cases, the average number of entries being 7.

Farriery.—Classes were held at 2 centers, and 51 pupils received instruction. An annual competition was also held in connection with a local agricultural show.

Scholarships.—Four £60 horticultural scholarships tenable at the Horticultural College, Swanley, and two scholarships of the value of £60 each and two of the value of £30 each, tenable at the South Eastern Agricultural College for two years, were awarded in 1899–1900.

Experiments in the manurial treatment of hops were carried on at four stations under the superintendence of the South Eastern Agricultural College, full accounts of which were given in the college journal. An experiment was also conducted by the county superintendent of horticulture in the preservation of fruit by means of cold storage. A report on the same was published in the thirty-third quarterly report of the technical education committee.

The work of the county councils, as exhibited in the foregoing reports, has been conducted since 1890 with continually increasing interest and profit. The movable school, it will be observed, is the distinguishing feature of their educational methods for agricultural improvement, and its popularity and value are due to the systematic and efficient way in which these schools are conducted. Instead of numerous meetings of only two or three sessions each, fewer are held, but these are continued for at least ten to fifteen days. Instead of presenting many subjects for consideration, but one or at the most two are discussed, and these are treated in a carefully planned course of lectures, accompanied with practical demonstrations. Instead of large and motley assemblages of people being addressed, a fewer number are taught, and these are instructed in regular classes that meet day after day throughout the entire course.

The traveling schools are thoroughly equipped. They are provided with the newest and best apparatus in order that the scholars may have the advantage of seeing and using the latest and best machinery and most approved methods in use in the special line of work treated.

An examination of the reports also shows that the organization of the work providing for peripatetic instruction for farmers has been planned most carefully not only with respect to its present efficiency, but with the view also to its permanency and future development. The matter of continual and adequate support has been amply provided for. The county, out of its revenues from the excise fund, meets the largest part of the expense; at the same time each locality and individual directly benefited is required to bear a proper share of the cost.

The general policy controlling and directing the work has a like degree of permanency that contributes to the strength of the work. No change of national administration or depression in business or temporary political or social upheaval among the people can suddenly overthrow it. At the same time there is a degree of flexibility permitted in carrying out the scheme that permits of such gradual change and improvement as experience may show to be necessary.

College Work in Agriculture.

As has been stated, the funds provided under the original grant for agricultural education made by Parliament in 1888 were widely distributed. They were used to aid not simply the colleges and higher institutions of learning, but were likewise given for the support of the local schools established by the county councils. Later, when the counties became the recipients of aid from the excise fund, the parliamentary grant was withdrawn and given to the institutions which had been chosen by the board of agriculture in the several produce districts as centers for agricultural education.

In 1903–4 there were sixteen of these institutions receiving aid from the grant of the General Government. The University College of North Wales, at Bangor; Yorkshire College, at Leeds; Durham College of Science, at Newcastle-on-Tyne; Cambridge University, at Cambridge; South Eastern Agricultural College, at Wye; University

College of Wales, at Aberystwyth; University College, at Reading; Midland Agricultural and Dairy Institute; Harper Adams Agricultural College; British Dairy Institute, Reading; Agricultural and Horticultural School, Holms Chapel; Agricultural and Horticultural College, Wickfield; Harris Institution, Preston; Eastern Counties Dairy Institute, at Ipswich; National Fruit and Cider Institute; and Cumberland and Westmoreland Farm School.

Each of these is a center and acts for one or more counties. The University College of North Wales, at Bangor, is a center for the counties of Anglesey, Carnovan, Flint, Denbigh, and part of Montgomery. The Durham College of Science is a center for the counties of Northumberland, Durham, and Cumberland, and the other institutions act as centers for similar groups.

These institutions, besides giving instruction in agriculture in their regular courses indoors, leading to appropriate academic degrees, engage likewise in "external" instruction work out in the counties that compose their respective districts. This work consists of courses of lectures and demonstrations before classes in various localities or centers made up of farmers or farmers' boys.

The parliamentary grant was declared to be in "aid of agricultural and dairy schools and for agricultural experiments." It is therefore applicable to all forms of agricultural instruction, such as the training of teachers and local lecturers, the equipment of dairy schools, the conducting of experiment farms, and fields of demonstration.

The general educational scheme of such a collegiate institution is outlined in one of the reports of the secretary of the board of agriculture as follows:

> I. The training of agricultural teachers.
>
> II. The imparting of direct education in the sciences bearing on agriculture to resident pupils.
>
> III. The diffusion of general knowledge and a promotion of a spirit of inquiry among those already engaged in agricultural work by means of peripatetic lectures and evening classes.
>
> IV. The technical training of pupils or of actual workers in special forms of agricultural industry, such as dairy work, forestry, fruit growing, etc.
>
> V. The conducting of experiment work, affording in different centers means of illustrating the bearing of scientific research on exemplary agricultural practice.

The special purpose of the Government in organizing these "collegiate centers" is outlined in a report of the board of agriculture for 1895. The report states that—

> The collegiate centers are intended to provide efficient and regularly organized indoor training for a certain more or less necessarily limited number of students pursuing a continuous course of study for two or more consecutive years. They also offer a variety of other and more temporary courses of instruction.
>
> The educational staff and machinery of the center is also made available for the work of the surrounding county authorities and in part for the conduct of

itinerant or local classes and for the direction of field demonstration or feeding experiments.

The University College of North Wales, at Bangor, was the first to originate such a typical school and to supply a "complete and very extensive system of agricultural instruction for a group of counties." The plan has now been adopted by all of the ten institutions receiving aid from the parliamentary grant.

EXTERNAL WORK OF THE COLLEGES.

The external work varies somewhat in its details among these institutions, but conforms nevertheless to one general plan. The plan consists in the establishing and maintaining, in whole or in part, of secondary schools at which instruction in agriculture is given by professors from the central college; in the conducting of traveling schools of agriculture that meet classes of pupils at numerous centers throughout the district over which the influence of the college extends; in arranging and maintaining in the several counties experiment farms and demonstration fields and farms where agricultural operations of the latest and most approved character are conducted.

The methods employed in organizing and conducting the traveling schools are substantially those in use by the county councils. The classes are organized in different centers and are given instruction in but one subject. The series of lectures and demonstrations upon that subject constitute a course which usually requires about ten days to complete.

By this method of devoting all of the time to a single topic experience has shown that better results are secured than where the course consists of lectures upon several subjects. By concentrating upon one topic reasonably thorough instruction can be given in that branch, whereas by the other method of treating several subjects a vague and unsatisfactory impression is too frequently the only result.

Inasmuch as the colleges receiving aid from the Government grant for agricultural instruction are the agents of the board of agriculture in its work of aiding the farming people by means of traveling schools, no statement of the system of peripatetic instruction in Great Britain is complete that fails to show what these institutions are doing outside of their stated indoor work at the collegiate centers. And since the methods used by the several institutions in conducting their movable schools differ quite materially from each other, it has been deemed advisable to present somewhat in detail the work of those whose systems differ most widely.

The following extracts from the reports of the inspectors appointed by the board of agriculture to visit the collegiate centers for the year which ended March 31, 1901, have been selected as showing what is being done and the methods which each collegiate center referred to has adopted in carrying on its "outside" work:

UNIVERSITY COLLEGE OF NORTH WALES.

EXTERNAL WORK.

Dairying.—At the dairy school at Lleweni Hall, near Denbigh, instruction was given, as in previous years, in cheese making, butter making, and in dairying generally. The total pupils were in excess of former years, having numbered 101, of whom 74 came for periods of six weeks. A considerable number of these, viz, 36, came with county scholarships from Flint, Denbigh, and Anglesey, half of them under the regular schemes whereby those who have shown themselves proficient at the traveling classes during the year are awarded scholarships to the fixed school, and half under a special scheme in the counties of Flint and Denbigh to encourage persons to avail themselves of the lengthened courses in cheese and butter making held at the school.

At the Bangor dairy school, opened as usual at the college, 14 pupils attended a special fortnight's course in butter making, all having been awarded scholarships for this purpose by the councils for Anglesey and Carnarvonshire, after they had shown aptitude as pupils at the traveling schools held in those two counties.

Examinations were held twice during the year at the Denbigh school and once at the Bangor school. The awards at these examinations were—

Advanced certificates in dairy work	5
Ordinary certificates in cheese making	14
Ordinary certificates in butter making	41

Traveling schools for butter making instruction were held as follows:

In Anglesey there were courses of ten days' instruction given at 2 centers. The pupils numbered 23, and of these 18 took the full course.

In Carnarvonshire instruction was given at 3 centers, a second course being held at one of them. Forty-two pupils attended, of whom 34 took a full course.

In Flintshire courses of ten days' instruction were held at 3 centers. At 2 of these the instruction was on cheese making, and at the other on butter making. The courses were attended by 19 persons, all of whom remained for the full period of instruction.

In Denbighshire similar courses were held at 3 centers, those at 2 centers being on butter making, and at the remaining center on cheese making. The total pupils who attended numbered 30, of whom all but two took the full course.

Field demonstrations.—In Anglesey, irrespective of the college farm, experiments were conducted at 5 centers. At 3 of these the experiments were of a manurial character, the crops being swedes or pasture; at the remaining 2 centers the experiments had reference to the suitability of different seed mixtures in laying land down to grass.

In Carnarvonshire experiments on the manuring of swedes and pasture took place at 5 centers, while the interesting series of experiments on the improvement of rough hill pasture, referred to in previous reports, was continued at 5 centers. Charlock spraying experiments took place at 3 centers.

In Flintshire experiments were conducted at 4 centers, all on grass land, one set being on the hill pasture just mentioned, while in Denbighshire pasture experiments were in progress at 2 centers.

In Montgomeryshire there was an experiment on hill pasture at 1 center.

Lectures.—In Anglesey courses varying from 2 to 8 lectures each were delivered at 7 centers on one or other of the various subjects offered by the college. The lectures were attended by an average of 34.

In Carnarvonshire courses of from 2 to 5 lectures were given at 6 centers, but a second course was given at 1 of these, and no less than 4 courses (making in all 22 lectures) at another center. The average attendance was 34.

In Denbighshire courses were given at 6 centers, the average attendance being 47, while in Flintshire a course of 5 lectures on farm crops and their cultivation was given in an intermediate school to a class of 12 boys.

In Montgomeryshire the centers where lectures were given numbered 8, and those who attended them averaged 40 at each center.

Yorkshire College, Leeds.

EXTERNAL WORK.

Dairying.—The traveling butter school was only at work in the West Riding, where 10 centers were visited, at 1 of which a second course was held. A total of 92 pupils came under instruction, of whom 69 took the full course of ten days.

Field demonstrations.—As mentioned in last year's report, these are all arranged so as to have some connection with those conducted under the most careful supervision at the county farm. The number of centers in the East and West Ridings at which they were conducted amounted last year to 24, comprising 44 experiments with cereals, roots, and grass. In every instance a lecture was given at the center, explaining the results.

Lectures.—In the East Riding courses of lectures on general agricultural subjects were given at 7 centers, and single lectures on the results of experiments at 12 centers. Courses on horticulture were given at 8 centers, and on poultry keeping at 2 centers. The average attendance at all these lectures was 38.

In the West Riding the centers where courses on agricultural subjects were delivered numbered 10, and where single lectures were given numbered 18, of which 5 were places where courses had also been given, the lecture in this case, as in most others, dealing only with the results of the field experiments. Horticultural instruction was given at 19 centers, the courses at 17 of these being of 5 lectures, while a second course, similar in length, was given at 1 of them. Lectures on poultry keeping, consisting in most instances of a course of five lectures, were delivered at 11 centers. The average attendance per center was 39, and on this basis the total number attending these lectures must have been over 2,300 persons.

In the North Riding courses in agricultural subjects were given at 14 centers, and a second course at 2 of them, 6 of the courses consisting of lectures and the remainder of 5 lectures. Those on horticulture, all of which were 5 in number, were given at 21 centers, and those on poultry keeping of similar length, at 12 centers. The average attendance at each center was 36.

It is now nearly ten years since lecture work at local centers was undertaken in Yorkshire by this college, and it was thought a few years ago that the interest they called forth would gradually cease. The contrary seems to be the case, and the lecturers report that not only are the best centers those where lectures have been held before, but that amongst farmers generally in the county there is now an altogether higher scale of intelligence from a scientific point of view, and matters can now be profitably discussed amongst them which it would have been impossible to treat upon six or eight years ago.

It must be noted that in the East and West Ridings the work of horticulture is not confined to lectures. Gardens are started in a variety of places, as mentioned in last year's report, for the young, by means of "school" gardens in connection with the evening continuation schools, and for those who are older by means of what are termed "education" gardens. In each case, however, the gardens are under the general supervision of the horticultural staff at the college, and thoroughly useful work seems to be performed.

CAMBRIDGE UNIVERSITY.

EXTERNAL WORK.

Field demonstrations.—These, which have consisted of experiments on a variety of crops, have been conducted in conjunction with the various county councils, as follows:

In Cambridgeshire, at 7 centers, 2 of the experiments being on a rotation of crops. The manurial treatment of fruit trees formed the subject of experiment at 3 centers.

In Hertfordshire experiments were carried out at 2 centers. At one of these the experiment was on the hay crop; at the other 3, separate rotation experiments were conducted.

In Huntingdonshire an experiment was conducted at 1 center on the hay crop, and at another, of 8 acres, on various mixtures for laying down to grass.

In the Isle of Ely experiments on the potato crop were carried out at 2 centers.

In Norfolk experiments were conducted at 2 centers on laying down land to grass, while at one of them a second trial was made on the growth of sugar beet.

In Northamptonshire an experiment was carried out at 1 center on manuring for the hay crop.

In East Suffolk the county station at Bramford, together with a fresh one in a different part of the county, came under the supervision of the agricultural department of Cambridge. An experiment on a rotation of crops was also commenced by the department at the Colonial College, Hollesley Bay.

In West Suffolk, at 2 centers, a rotation experiment was carried on.

In addition to these, experiments on the influence of manures on the production of mutton were commenced at 4 centers. In Northamptonshire, on an area of over 30 acres, the trial was conducted on behalf of the board of agriculture on precisely the same lines as the original experiment in Northumberland. In Cambridgeshire, on an area of 16 acres; in Essex, of 18 acres; and in Norfolk, of 20 acres, an experiment was commenced which was a modification of the original one. During the past year on all these stations the grazing tests were of a preliminary character, without the application of manures. In Norfolk a further experiment was commenced in the growth of 10 acres of swedes for a bullock-feeding experiment.

Addresses in connection with the various experiments were delivered before several chambers of agriculture.

MIDLAND AGRICULTURAL AND DAIRY INSTITUTE, KINGSTON.

EXTERNAL WORK.

Dairying.—A traveling butter school has visited 8 centers in Derbyshire and 3 in Nottinghamshire. The numbers attending in the former county were 77 and in the latter 29. In every case the pupils remained for the full ten days' course.

Field demonstrations.—In Lincolnshire these were conducted at 5 centers, the experiments in one instance being on potatoes and in the others on barley.

In Nottinghamshire experiments were conducted at 4 centers, two or three sets being carried out at 3 of them. The crops concerned were potatoes, barley, and swedes. In addition there were various charlock spraying demonstrations, while the experiment on cropping a poor sandy soil with a view of endeavoring to increase its fertility, which was commenced some few years back, is being continued.

In Leicestershire an experiment was conducted at 1 center to test the influence of manures on the mangel crop.

Lectures.—In Lincolnshire courses of 5 or 6 lectures on general agricultural or dairy subjects were delivered at 9 centers, the average attendance being 15. Courses of 6 lectures on veterinary subjects were given at 2 centers to an average audience of 35. Horticultural lectures, numbering 3 or 4 at each place, were given during the winter at 10 centers, the average audience being 24, while in the previous summer 2 lectures each were delivered at 5 centers to an average audience of 26.

In Nottinghamshire courses of 3 or 4 lectures on general agricultural subjects were given at 3 centers, while single lectures were delivered at 3 other centers, the average audience numbering 30. Veterinary lectures were given at 4 centers, the course consisting of 6 lectures at 2 of the centers and 4 at the others, the audience averaging 38. Horticultural lectures or demonstrations were given in the summer at 6 centers to an average audience of 24 persons, while courses of 3 or 4 lectures in winter were given at 10 centers to an average audience of 44. Courses of 3 lectures on poultry keeping were given at 6 centers, the audience averaging 50.

In Derbyshire courses of 4 lectures on general agricultural subjects were given at 8 centers to an average audience of 18, while courses of 3 lectures on poultry keeping were given at 10 centers to an average audience of 47. Lectures on horticulture by the county instructor, who is now also on the general staff of the institute, were given at 19 centers during the winter, the average audience being 44. During the summer demonstrations were given on the two county fruit plats and in gardens or allotments at 13 other places. They were attended by an average audience of 46 persons.

In Leicestershire single lectures on dairying were given at 3 centers to average audiences of 36. Courses of 4 lectures each on veterinary subjects were given at 3 centers to average audiences of 32, while courses of 3 or 4 lectures on poultry keeping were given at 4 centers to audiences averaging 41. Horticultural courses of (with one exception) 4 lectures each were given at 6 centers. The average audience was 25. Summer lectures or demonstrations were also given at 2 centers, being attended by an average audience of 27 persons.

The other collegiate institutions aided by Parliament conduct similar operations. The four here given are, however, typical of the practice of all.

It is manifest that these colleges regard the external work that they have undertaken in aid of agriculture as most important, for in endeavoring to fulfill their mission, which is to occupy the entire field of agricultural instruction, they have had the courage to break away from the traditional practice of colleges of learning in the past that confined their teaching to the walls of the class rooms of the institutions themselves, and have extended their aid to men and women unable to leave their homes and go to school.

An interesting and important feature of the traveling school of instruction is indicated in the courses prescribed by the county councils under the designation "manual processes." These are taught in courses adapted to each subject and constitute an important branch of education. They comprise bee keeping, farriery, veterinary science, dairying, fruit culture, market gardening, cider and vinegar making, sheep shearing, plowing, stacking, ditching, thatching, care of live stock, pruning, milking, etc. The usefulness of knowledge and skill in the performance of all of these processes is acknowledged, but, as has been stated, it is only recently that the higher agricultural institutions of learning have come to realize that part of their duty is to see that information respecting these and kindred subjects is made accessible to the mass of country people.

The effect of the new departure in giving instruction in agriculture in Great Britain is strikingly exhibited by comparing a statement made in the report of the parliamentary commission appointed in 1887 to investigate the condition of agricultural education in Great Britain with a corresponding statement by the board of agriculture made in 1895. The commission called attention to the fact that a Scotch witness stated that certain associations of farmers desiring to improve their systems of dairying endeavored to obtain a skilled teacher in the art of butter making, and "that they had to send to Denmark and engage a Dane to come to the district and teach them to make butter." It was also stated that scarcely two years prior to 1887 "the managers of the Cheshire Dairy School could find no efficient teacher of butter making in Great Britain, and had to engage the services of a skilled dairy maid, who had been instructed at the Merster Dairy School near Cork." Contrast this with the report made by the secretary of the board of agriculture of Great Britain seven years later—in 1895. The secretary states that "dairying is now taught in some form or other under the county councils of all of the counties of England and Wales, excepting London and Middlesex. Similar instruction is now given in more than half of the administrative counties of Scotland."

The change in this brief period in this one industry has been wrought through the new methods of education which were begun in 1888, which consist in conveying valuable, practical instruction in agriculture, by means of skilled teachers, to people at work upon the land without requiring them to leave their homes or neglect their daily duties in order to receive the information which is offered.

SUMMARY.

The institutions in Great Britain charged with carrying on the work of giving agricultural instruction may be grouped into two distinct classes, not including the board of agriculture, which is the head of the entire system.

The first is composed of the agricultural colleges and schools acting as centers for groups of counties, and confining their efforts for the most part to the development of education in the areas which have been assigned to them. Their work consists in:

I. The giving of advanced class-room instruction to resident students.

II. The establishing of secondary schools of agriculture throughout their respective districts, usually confining the work of instruction to a single subject.

III. The equipping of peripatetic schools which visit various localities and give instruction to classes for periods of from one week to ten or fifteen days, each course being limited to the treatment of but one branch of agriculture.

IV. The establishing and maintaining of experiment and demonstration farms throughout their several districts.

The second class is made up of the county councils, who are in control of technical education work in the several counties. Under their direction are established:

I. Secondary schools of agriculture maintained wholly or in part by the county councils out of the excise fund.

II. Itinerant schools which visit various parts of the several counties and give short courses of lectures and demonstrations to classes on agricultural subjects.

III. Demonstration farms for testing the effects of various fertilizers, the adaptibility of seeds, the value of various breeds of live stock, methods of culture, etc.

The county councils also:

I. Establish and maintain scholarships in agriculture in the collegiate centers of their districts, available to young men of merit who wish to secure an agricultural education.

II. They likewise grant premiums for meritorious work in agriculture in their several counties.

III. They aid their agricultural colleges by making annual appropriations for their support from the excise fund.

IV. They cooperate with the board of agriculture of Great Britain in devising and introducing improvements in agricultural education throughout the Kingdom.

The marked features of the system as a whole are:

I. That it reaches all classes of farmers in all parts of the country with valuable instruction, and does this systematically and every year.

II. That the universities and colleges have extended their activities to the outlying communities. They have recognized their duty to the farming people, who are unable to leave their farms to attend classes at the collegiate centers, by carrying instruction to them at their homes.

III. That each county is provided with means to carry on its educational work independent of support from the general government, and that a capable and responsible body in each county is intrusted with the oversight and control of the work, and with the disposition of the public money contributed in its behalf.

IV. That it is equipped with teachers who are expert authorities in some one branch of agriculture.

V. That it is organized upon a firm and substantial basis, and is recognized by both local and national authorities as an important part of the general system of public instruction.

VI. That it is adapted to future improvement and expansion as knowledge increases and the requirements of agriculture demand.

IRELAND.

The control of the work of providing instruction in agriculture in Ireland is under the supervision of a department constituted by act of Parliament in 1899. The act provides that "there shall be established a department of agriculture and other industries and technical instruction for Ireland, with the chief secretary as president thereof, and a vice-president appointed by and removable at the pleasure of one of Her Majesty's principal secretaries of state."

The department is authorized "to make, or cause to be made, or aid in making such inquiries, experiments, and research, and collect or aid in collecting such information as they may think important for the purposes of agriculture and other rural industries," and with the consent of the lord lieutenant and the treasury "to appoint or employ a secretary, two assistant secretaries, one in respect of agriculture and one in respect of technical instruction, and such inspectors, instructors, officers, and servants as the department may require.

For the purpose of assisting the department in carrying out the objects of this act it is provided that "there shall be established (*a*) a council of agriculture; (*b*) an agricultural board; (*c*) a board of technical instruction."

The council of agriculture is composed of "two persons appointed by the county councils of each county (other than a county borough) in each province, and a number of persons resident in each province equal to the number of counties (exclusive of county boroughs) in the province to be appointed by the department." The members representing each province "shall constitute separate committees on the council and shall be styled the provincial committees of the respective provinces."

The agricultural board consists of two persons appointed by the provincial committees of each province and four persons appointed by the department.

The board of technical instruction consists of (*a*) "3 persons appointed by the county councils of each of the county boroughs of Dublin and Belfast; (*b*) 1 person appointed by a joint committee of the councils of the several urban districts in the county of Dublin, such committee to consist of 1 member chosen out of the body by the council of each such district; (*c*) 1 person appointed by the council of each county borough not above mentioned; (*d*) 1 person appointed by the provincial committee of each province; (*e*) 1 person appointed by the commissioners of national education; (*f*) 1 person appointed by the intermediate education board; (*g*) 4 persons appointed by the department."

The duties of the council and of the several boards are defined by the act, as follows:

> I. The council of agriculture shall meet at least once a year, for the purpose of discussing matters of public interest in connection with any of the purposes of this act.
>
> II. The agricultural board shall advise with the department with respect to all matters and questions submitted to them by the department in connection with the purposes of agriculture and other rural industries.
>
> III. The board of technical instruction shall advise the department with respect to all matters and questions submitted to them by the department in connection with technical instruction.

The corporate name of the department is "The Department of Agriculture and Technical Instruction for Ireland," and it is clothed with the power to acquire and hold land for the purposes of the act and may sue and be sued as in case of other corporate bodies. Parliament by this act places at the disposal of the department funds derived from a number of separate sources, and also prescribes the method of their apportionment.

There is also established by this act a committee of 5, known as a "consultative committee," for the purpose of coordinating educational administration. The committee is composed of the vice-president of the department, who is ex officio its chairman; 1 person appointed by the commissioners of national education; 1 person appointed by the intermediate education board; 1 person appointed by the agricultural board, and 1 person appointed by the board of technical instruction.

The council of agriculture consists of 104 members, 68 of whom are appointed by the county councils and 34 by the department from the several provinces, with the president and vice-president of the department as ex officio members. The members of this council hold office for three years.

The agricultural board as constituted consists of 12 members, 8 appointed by the provincial committees and 4 by the department of agriculture.

The board of technical instruction consists of 21 members, who hold office for three years, whose duties, as in the case of the agricultural board, are advisory. They "advise the department with respect to all matters and questions submitted to them by the department in connection with technical instruction."

The consultative committee of education is composed of 5 members, and their duty is to "coordinate educational administration." The importance of the functions of such a committee is manifest, for the educational work of the department as respects agriculture is intimately associated with that of primary as well as secondary and higher education. The harmonizing of these systems so far as the work relates to agricultural industry is therefore the important duty assigned to this committee. All work, therefore, relating to agriculture or instruction in agricultural subjects in Ireland is performed under the supervision of the department of agriculture and technical education.

The act, nevertheless, provides for local cooperation. County and urban district councils are authorized to raise annually a sum not exceeding 1 penny per pound on the ratable value of such ratable or rural district, and may apply the revenue that is derived for the purposes of agriculture or "for any other purposes for which they are authorized by the act to expend money."

The six county boroughs are authorized to formulate their own schemes of agricultural instruction, and the counties outside of the county boroughs are, under the administration of the act, intrusted by the department with the local administration of such schemes of instruction as they, in consultation with the department, may adopt, the declared purpose being to "strengthen the spirit of economic and social self-help among the people" by bringing "the local bodies thus into contact with the difficulties of the problems to be dealt with."

The council in each county has authority, under the agriculture and technical instruction act of 1889, to appoint a county committee to have charge of the work of technical instruction in agriculture, which committee has authority to select the districts at which lectures shall be given and to appoint district committees each with a local secretary. This local secretary is charged with the duty of selecting the building for meeting and arranging for the hiring, warming, and lighting of the hall.

Assistance in local organization is rendered by the department by sending representatives to visit and confer with every local authority and, after careful inspection and examinations of the local conditions, aid by offering them expert advice. The purpose of this dual organization is to encourage, on the one hand, local initiative and responsibility, and on the other, to guard against the indiscriminate multiplication of unrelated local organizations by providing a central authority to see that the work is coordinated so as to promote the best interests of the country as a whole.

The method pursued by the department in organizing and conducting itinerant schools is given in the following scheme of instruction in agriculture:

(1) The department is prepared, provided a suitable instructor in agriculture can be obtained, to approve of the appointment of at least one such person for each county in Ireland.

(2) The department will, as far as possible, assist the county committee in obtaining an instructor, by supplying the names of persons qualified for the post.

(3) The remuneration of the instructor shall not, except in special cases, exceed £200 per annum, inclusive of maintenance and hotel expenses, in addition to expenses of locomotion, which include second-class railway fare, car hire when necessary, or a bicycle allowance of 2d. per mile in lieu thereof.

(4) The appointment of the instructor shall be terminable at any time by three months' notice in writing on either side.

(5) It will be the duty of the instructor to deliver courses of lectures on agricultural subjects, such as soils, manures, seeds, pastures, crops and their cultivation, breeding, feeding, and management of live stock; to visit farms; to conduct such experiments and demonstrations in spring and summer as may be approved by the department; to select suitable land for this purpose; to supervise the sowing of the seeds and manure and the keeping of the plats free from weeds; to weigh the produce, tabulate the figures, and prepare a report on the results; to reply to letters from farmers seeking information; to advise farmers how they may avail themselves of the department's live-stock schemes and of the department's seed-testing station; to make known the provisions of the fertilizers and feeding stuffs act; to advise farmers how they can best avail themselves of all schemes which may be adopted by the county committee and by the department, and how they may take advantage of agricultural organization; to report to the department and to the county committee regarding the progress of his work as may be required; and, generally, to give his whole time to the work and do all in his power to further the interests of agriculture in the county.

(6) For the purposes of this scheme the county should be divided into circuits, each comprising not less than 5 centers. The instructor should work for at least four weeks in each circuit, and deliver one lecture per week at each center during that time. The instructor will, when invited to do so, visit, either on the day of the lecture or on the following day, any of the farms in the neighborhood, and give such information on practical subjects as the circumstances of the case may suggest.

The county committee are alone responsible for the selection of centers and arrangement of lectures. No work of this nature should be undertaken by the instructor, though it is desirable that he should be consulted.

(7) It will be the duty of the county committee to select centers at which the lectures will be given and to appoint a local committee, with an honorary secretary at each center, who should select the school or other building and

arrange for the hiring, lighting, and warming of the room in which the lectures will be delivered.

It will also be the duty of the county committee to undertake the responsibility of seeing that the instructor's time is fully and usefully employed.

The county committee shall keep a separate account of all expenditure under this scheme and shall furnish detailed statements of such expenditure as may from time to time be required by the department.

(8) Lectures should be arranged to be given in schoolrooms in the evenings, and should be held in rural centers. Towns and the larger villages should be avoided, as experience has shown that the greatest success attends those lectures which are given in the rural parts of the county, especially when the lectures are delivered in a district where the greatest number of farmers is to be found. The local committee at each center should be responsible for appointing a representative chairman for each lecture, as well as for the distribution of the short syllabus of the lectures, which will be prepared by the lecturer as soon as he is appointed. The local committee should undertake to have posters, which will be supplied by the secretary of the county committee, effectively displayed throughout their district. Each lecture should be followed by a discussion, during which farmers will be invited to ask questions relative to their business.

(9) The lectures should commence early in autumn and be continued until the end of the first week in March.

(10) No action shall be taken by the county committee toward putting this scheme, or any part thereof, into operation until the sanction of the department has been obtained in writing.

It will be observed that while the instructor in any agricultural subject is selected by the committee of the county in which he is to work, the choice of the committee is not final until the department has been satisfied as to the qualifications of the person selected and has sanctioned the appointment in writing. This insures that only capable teachers will be engaged in instruction work in itinerant schools.

Two classes of instructors are employed by the department in its technical instruction work in agriculture. The first is composed of what are known as itinerant instructors, who conduct short courses in some subject, such as poultry keeping, dairying, bee keeping, etc. These are trained men who are thoroughly qualified for the work which the subjects require.

The second class is composed of what are known as pioneer lecturers, sent out by the department for the purpose of giving a series of pioneer lectures upon practical agriculture—dairying, poultry keeping, horticulture, and kindred topics—in counties which have been unable to secure itinerant instructors.

In the case of the pioneer lecturers the department pays out of the funds at its disposal the fees and traveling expenses of these lecturers. In the case of the itinerant instructors in agriculture, the department pays their full salaries, but the cost of traveling through the county is defrayed out of the local fund raised by the county council from the rate of 1 penny in the pound on the valuation of the county property, supplemented by at least an equal amount from the department funds. The salaries and expenses of all other instructors are defrayed out of this joint fund, which is administered by the county committee.

The itinerant instructors in agriculture are employed, as a rule, all the year round. In some counties, however, the instructors in poultry keeping, horticulture, bee keeping, etc., are employed for nine months of the year only. During the winter months the instructor is employed five evenings in the week in lecturing. He also replies to letters from farmers in the county under his charge, who ask advice on matters relating to farming operations, and visits during the daytime farmers in the vicinity in which the lectures are held. The visits are made for the purpose of enabling the instructor to acquaint himself with the character of the farm land in the district under his charge, thus enabling the lecturers to select suitable land for the purpose of the variety and manurial tests which they conduct during the spring and summer months. These visits are also of value in providing opportunity for farmers to consult an expert respecting the local difficulties which affect them.

The county committee is required to see that the instructor's time is fully and properly employed, and that a short syllabus of each lecture is prepared by the lecturer and distributed among the people.

The assistant secretary of agriculture of Ireland reports that there were at work on the 31st day of March, 1904, 80 county instructors distributed over 33 counties. The following table exhibits the character and extent of this work:

Number of instructors in agricultural subjects at work in Ireland during the year 1903–4 and the number of lectures delivered and average attendance thereat.

Scheme.	Number of counties at work.	Number of itinerant instructors.	Number of lectures.	Average attendance.
Agriculture	14	15	1,159	64
Poultry keeping	31	32	2,820	90
Butter making	10	12	1,594	52
Horticulture	14	[a] 14	550	70
Bee keeping	13	7	65	60

[a] Of these, 6 gave instruction in bee keeping also.

The expense for conducting this work during the year amounted to $152,355.24, of which amount $53,786.62 was derived from the local tax of 1 penny on the pound referred to, and $98,568.62 from the department funds.

In addition to the courses of lectures delivered, the department from time to time issues leaflets on agricultural subjects. These leaflets are distributed free to applicants, and also to a regular mailing list of farmers whose names have been listed by the department. The subjects cover a varied and wide range of topics, as charlock spraying, fluke in sheep, wireworms, contagious abortion in cattle, prevention of potato blight, the use and purchase of manures, etc.

In order that the exact character of the itinerant schools may be understood, the following schemes, taken from reports of county committees on agriculture for the year 1904, are presented:

Scheme of Instruction in Poultry Keeping for Itinerant Schools of Agriculture in the County of Kildare, Ireland.

Mr. ——— has been appointed instructor in poultry keeping at a salary of £3 per week, with necessary expenses of locomotion in the county, which includes third-class railway fare, car hire when necessary, or a bicycle allowance of 2d. per mile in lieu thereof.

The appointment of the instructor shall be terminable at any time by four weeks' notice in writing on either side.

DUTIES OF INSTRUCTOR.

The instructor's duty shall be to deliver courses of lectures on poultry keeping, including the selection of breeds; the hatching and rearing of chickens; the feeding and housing of poultry generally, and the marketing of the produce; to visit poultry runs and give such practical advice as may be desired by poultry keepers; to inspect egg-distributing stations; to report to the department and to the county committee regarding the progress of his or her work as may be required; and generally to give his or her whole time toward promoting improvement in the poultry keeping in the county.

CENTERS.

For this purpose the county will be divided into five circuits, viz, Naas, Athy, Carbery, Celbridge, and Kildare, each comprising not less than five centers.

The instructor shall work for at least four weeks in each circuit, and deliver one lecture per week at each center during that time.

The county committee shall select the centers at which the lectures will be given, and appoint an honorary secretary and a local committee at each center, who should select the school and arrange for the hiring, lighting, and warming of the room in which the lectures will be given.

These lectures shall be arranged as far as possible to be given in schoolrooms, and to be held in rural centers. Unless in exceptional circumstances, no lecture will be arranged for in a large village or town.

Lectures will commence in November and be continued until May.

The county committee undertake the responsibility of seeing that the instructor's time is fully and usefully employed.

DISTRIBUTION OF SETTINGS OF EGGS OF PURE BREEDS.

There shall be offered twelve premiums of £5 each to select applicants who distribute at least 60 settings of eggs each; those who distribute less will be paid in proportion to the number distributed. When the demand for settings of eggs is not pressing the owner may set eggs for his own use, but such settings of eggs will not count toward a premium.

Applicants for premiums must be prepared to comply with the following conditions, viz:

(1) To keep one pure breed of poultry only. One of the following breeds of hens and ducks must be selected:

Laying breeds.—Minorcas, White Leghorns, Brown Leghorns.

General-purpose breeds.—Houdans, Plymouth Rocks, Orpingtons, Faverolles.

Ducks.—Aylesbury, Rouen, Pekin, Indian Runner.

(2) To sell or destroy any existing fowl on the farm of which the instructor or the department may disapprove, and not to bring on the farm fowl of any description without the approval of the instructor or of the department.

(3) To keep no male birds on the farm other than those used for stock purposes of the breed or breeds of fowl approved of.

(4) When a premium is claimed for hens alone, to keep not less than 30 nor more than 60 of the selected breed. If the premium is claimed in respect of hens and ducks, to keep not less than 20 nor more than 60 hens or pullets of the selected breed, and not less than 10 nor more than 30 ducks of the selected breed. One cock or cockerel must be kept for every 10 hens or pullets, and 1 drake for every 6 ducks.

(5) To provide proper housing where such does not already exist.

(6) To feed and care for the birds in such a manner and in such a way as the instructor and the department may require.

(7) To supply settings of eggs from these birds to any person in the county at 1s. per dozen, and to replace infertile eggs that are returned within one month from the date on which they were sent out.

(8) To stamp all eggs given out with a stamp provided for the purpose by the county committee.

(9) To keep in a special book provided by the county committee an accurate account of all eggs laid and distributed. This book must be sent to the secretary of the county committee or to the department when asked for by either of these bodies. The books should be returned to the secretary of the county committee at the end of the hatching season, which will commence on the 1st of January and terminate on the 31st of May.

(10) To permit the instructor or the department to inspect the birds at any time.

Any infringement of the above rules may entail the cancellation of the premium.

An additional grant of 50 per cent of the actual cost, but in no case exceeding £2, may be made to the selected persons who provide themselves with portable wooden fowl houses approved by the department. This will only apply to persons who are taking up the scheme in 1903–4 for the first time.

The county committee will invite applications from persons in the county who already possess, or are willing to purchase, pens of the approved pure breeds of fowls or ducks, or to keep one or more pure-bred turkey cocks, as above, and who are prepared to comply with the above conditions. When these applications have been received the county instructor in poultry keeping will, as soon as possible, inspect and report to the county committee as to the number of suitable applicants. The names of the selected applicants, with full particulars as to the breeds, number of birds, and housing, should then be submitted for the approval of the department, who may thereupon further inspect the selected farms and submit a list of those of which they approve to the county committee for their final selection.

The county committee will not consider applications in respect of premiums under this scheme later than the 1st of December, 1903.

On account of the difficulty of procuring stock birds of pure breeds late in the season, it is recommended that selected applicants who intend to adopt this scheme should, if possible, have all arrangements completed prior to the 1st of January, 1904.

Not later than the 10th of June the selected applicants for premiums should forward to the secretary of the county committee the record books referred to above, accompanied by a statutory declaration certifying that the entries in these books are correct, and that all the conditions of this scheme have been complied with.

As soon as the department are satisfied as to the fulfillment of the conditions of this scheme, the secretary of the county committee will be notified that payment may be made by the committee of the premiums or part premiums payable under this scheme.

Forms for the declaration required may be had on application to the secreary of the county committee.

TURKEY PREMIUMS.

Five premiums of £3 are offered to persons who are prepared to comply with the following conditions:

(1) To keep one or more pure-bred American bronze stock turkey cocks for the service of turkey hens, the property of any persons residing in the county, at a fee of 6d. per service. Each cock must serve 20 hens, exclusive of the owner's. If a smaller number are served, the premium will be proportionately reduced. The turkey cock will require to be at least twelve months old, and not less than 23 pounds in weight.

(2) To provide proper housing accommodation, and to feed and care for the bird or birds in such a manner as the instructor or the department may require.

(3) To keep in a special book, provided by the county committee, an accurate record of services. This book must be sent to the secretary of the county committee or to the department when required, but otherwise returned to the secretary of the county committee at the end of the season, which will commence on the 1st of January and will terminate on the 31st of May.

(4) To permit the instructor or the department to inspect the birds at any time.

Any infringement of the above rules may entail the cancellation of the premium.

An applicant will be eligible for only one premium, either for hens or for hens and ducks combined, but he will, in addition, be eligible to hold a premium for turkeys. No premium, however, will be given for ducks alone

Scheme of Instruction in Butter Making for Itinerant Schools of Agriculture in the County of Kildare, Ireland.

DUTIES OF INSTRUCTOR.

The instruction shall take the form of daily lectures on dairying, accompanied by practical instruction in butter making.

Each course shall extend for a period of not less than two and not more than four weeks. Not more than 12 pupils shall be admitted to each class. Pupils must undertake to attend regularly.

On the first day of visiting each center, the instructor shall give a public lecture and demonstration, and during the remainder of the course at that center shall conduct a class daily, in which pupils only shall take part, but which shall be open to the public.

These classes shall be held, as far as possible, in schoolrooms and other suitable buildings in rural centers. Unless in very exceptional circumstances no class shall be held in a large village or town.

The county committee undertake the responsibility of seeing that the instructor's time is fully and usefully employed.

CENTERS.

For this purpose the county will be divided into the same five circuits as for poultry keeping.

Instruction will commence in May and be continued through the summer.

The county committee will select eight suitable centers at which classes will be held, and appoint at each center an honorary secretary and a committee, who will be responsible for the local arrangements necessary for the proper carrying out of the work, and who will be required to comply with the annexed conditions.

A total sum, not exceeding £8, will be set aside for prizes, to be given to the most successful students at the close of the course of instruction at each center—three prizes of the value of 10s., 6s., and 4s., respectively, to be given at each center.

CONDITIONS REQUIRED OF LOCAL COMMITTEES.

(1) To secure premises suitable for a working dairy, if possible not less than 25 feet by 18 feet or other dimensions affording similar floor space. Either a public room, schoolroom, or barn with a good floor would be suitable for the purpose.

(2) To secure a sufficient supply of water.

(3) To provide on the premises means of heating at least 15 gallons of water at one time, for use in cleaning utensils, etc.

(4) To provide sufficient milk and cream for use in the school, the local committee taking responsibility for the sale of butter. After the opening day at each center, about 3 gallons of milk and 6 gallons of cream will be required for each day's work. Arrangements should be made to have the milk and cream delivered in the morning.

(5) To guarantee not less than 6 and not more than 12 pupils to attend on each of the days over which the course of instruction extends.

(6) To arrange for the carriage of the utensils from one center to another. The weight of the utensils is usually from 25 to 30 hundredweight and they are somewhat bulky.

List of utensils of traveling dairy school of six churns.

	£	s.	d.
6 end-over-end churns, at £3	18	0	0
6 butter workers, at 37s. 6d	11	5	0
6 butter boards, at 2s	0	12	0
4 larger butter boards, at 3s. 6d	0	14	0
6 scoops, at 1s	0	6	0
6 sieves, at 2s. 6d	0	15	0
6 pairs Scotch hands, at 2s. 6d	0	15	0
6 squeegees, at 1s	0	6	0
6 scrubbing brushes, at 1s	0	6	0
6 thermometers, at 1s. 6d	0	9	0
6 white enameled buckets, at 5s. 6d	1	13	0
6 iron buckets, at 4s. 6d	1	7	0

	£	s.	d.
4 shallow tins (cream), at 4s	0	16	0
1 pair scales	0	19	0
1 set iron weights (7, 4, 2, 1, ½, and ¼ pound)	0	4	6
1 set brass weights (2, 1, ½, and ¼ ounce)	0	5	6
1 set creamometers	0	6	6
1 lactometer	0	1	6
1 Gerber butter-fat tester (2 bottles), about	2	10	0
1 two-quart measure	0	2	6
4 quart measures, at 1s. 9d	0	7	0
4 pint measures, at 1s. 3d	0	5	0
2 skimmers, at 8d	0	1	4
1 hand separator (9 gallons per hour)	5	10	0
	47	16	10

Scheme of Instruction in Horticulture for Itinerant Schools of Agriculture in the County of Kildare, Ireland.

Mr. ——— has been reappointed instructor in horticulture at a salary of £3 per week, with expenses of locomotion in the county (third-class railway fare), car hire, or bicycle allowance, as in the case of the agricultural instructor.

His appointment shall be terminable at any time by four weeks' notice in writing on either side.

DUTIES OF THE INSTRUCTOR.

His duties shall be to give lectures in the evenings, and personal advice to fruit, vegetable, and flower growers, in a similar manner to that described in the case of the itinerant instructor in agriculture; to visit orchards and gardens during the daytime, and to give practical demonstrations in planting, pruning, grafting, etc.; to report to the department and to the county committee on his work, as may be required, and, generally, to give his whole time to the work and to do all in his power to further the interests of horticulture in the county.

CENTERS.

Centers of instruction shall be fixed by the county committee, who shall also determine the length of the courses of lectures at each center.

The county has been divided in the same five circuits as for agriculture and poultry instruction. In each of these circuits one demonstration plat will be selected for the purpose of growing vegetables, flowers, and fruit, and showing improved methods of cultivation. A total sum not exceeding £36 has been set aside to cover the cost of seeds, manures, fruit trees, and, if necessary, fencing and labor, the labor, whenever practicable, to be given gratuitously by the person or persons providing the plats and the produce to be the property of the same persons. In cases in which such an arrangement is found to be impracticable the committee may employ hired labor, retaining the produce.

The plat in the Celbridge district may be situated in the Union grounds, as these are surrounded by at least 20 cottages. The selection of the different plats will be made by Mr. ———, subject to the approval of the committee and the department.

DISTRIBUTION OF FRUIT TREES.

The committee may purchase fruit trees in bulk and resell to farmers and cottages in the county, provided no loss is incurred in the transaction,

SCHEME OF INSTRUCTION IN BEE KEEPING FOR ITINERANT SCHOOLS OF AGRICULTURE IN THE COUNTY OF KILDARE, IRELAND.

An instructor in bee keeping, who must satisfy the department as to his qualifications, shall be appointed by the county committee, with the approval of the department. Preference shall be given to local bee keepers if qualified.

A sum of £27 has been set aside for this purpose.

DUTIES OF THE INSTRUCTOR.

His duties shall be:

(1) To give instruction on the principles and practice of modern bee keeping by means of lectures and demonstrations at any center where application is made for his services.

(2) To deal with bee diseases.

(3) To give advice generally and to assist in the promotion of the industry in such a manner as the county committee, with the approval of the department, may direct.

The examples given show the methods in operation in conducting itinerant schools. It is manifest that the scheme may be extended and adapted to include other agricultural specialties as rapidly as the money and teachers necessary can be secured for the purpose.

The system as outlined is a distinct advance upon the method of holding a few meetings in each county, in which a number of lecturers are employed to appear and deliver lectures of thirty to forty minutes, each lecture treating of a different topic. The new plan aims to do a few things well rather than many in a superficial and indifferent way. Each endeavors to develop the educational feature of the farmers' institute, so as to make it of permanent and of direct and immediate use to the farming population in improving their practice.

Provision is also made for the profitable employment of the institute instructors during the entire year by making it their duty, in connection with their work as teachers, to select and recommend locations for the carrying on of demonstration experiments throughout the several counties in which they work. When the individuals who are to conduct these experiments are selected by the county committee and have been approved by the department, the lecturer is expected to take charge of the work of organizing these experiment plats, to visit them from time to time and give advice as to their management, to keep records of their progress, and to report to the county committee the results.

The experiment plats are each one-twentieth of an acre in extent. Subjects and methods of experiment are prescribed by the department. Some of these subjects experimented upon in 1902 were oats, barley, potatoes, cheese making, calf feeding, seed testing, tobacco growing, flax growing, turnip growing, hay and pasture grasses, vegetable and fruit preserving, etc.

The experiments in crops were chiefly manurial and variety tests, except that those conducted with reference to hay and pastures included various mixtures of seeds with a view of securing the best varieties for these purposes.

The county committees are also utilized by the department in its efforts to improve the live stock of the county, in its distribution of prizes, in the encouragement of agricultural fairs, in securing the establishment and proper conducting of creameries, and in all of its other operations in the interests of agriculture in the several counties.

The county committee, therefore, is the executive of the entire system, without which no part of the work could possibly be effective. The moving force in the county committee is its secretary—a live, capable, active, and discreet secretary in every county is a necessity; without this all of the machinery of the system like that of a locomotive without an engineer will lie idle and useless, eventually to become fit only for the rubbish heap. On the other hand, with an effective secretary in every county the work of agricultural education and rural development will be rapidly and successfully advanced.

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U. S. DEPARTMENT OF AGRICULTURE.
OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 156.
A. C. TRUE, Director.

STUDIES
ON THE
DIGESTIBILITY AND NUTRITIVE VALUE OF BREAD AND OF MACARONI
AT THE
UNIVERSITY OF MINNESOTA

1903-1905.

BY

HARRY SNYDER, B. S.,
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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON THE FOOD AND NUTRITION OF MAN.

NOTE.—For those publications to which a price is affixed application should be made to the Superintendent of Documents, Government Printing Office, Washington, D. C., the officer designated by law to sell Government publications. Publications marked with an asterisk (*) are not available for distribution.

*Charts. Food and Diet. By W. O. Atwater. (Four charts, 26 by 40 inches.) Price per set, unmounted, 75 cents.

*Bul. 21. Methods and Results of Investigations on the Chemistry and Economy of Food. By W. O. Atwater. Pp. 222. Price, 15 cents.

Bul. 28. (Revised edition.) The Chemical Composition of American Food Materials. By W. O. Atwater and A. P. Bryant. Pp. 87. Price, 5 cents.

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[Continued on third page of cover.]

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 156.

A. C. TRUE, Director.

STUDIES
ON THE
DIGESTIBILITY AND NUTRITIVE VALUE OF BREAD AND OF MACARONI
AT THE
UNIVERSITY OF MINNESOTA

1903-1905.

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HARRY SNYDER, B. S.,

Professor of Chemistry, College of Agriculture, University of Minnesota, and Chemist, Agricultural Experiment Station.

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1905.

OFFICE OF EXPERIMENT STATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., May 30, 1905.

Sir: I have the honor to transmit herewith and recommend for publication as a bulletin of this Office, a report of investigations on the digestibility and nutritive value of bread, and of macaroni and a breakfast food made from American-grown durum wheat, carried on at the University of Minnesota in 1903–1905 by Harry Snyder, professor of chemistry in the State University and chemist of the Agricultural Experiment Station. The studies are a continuation of the investigations on the nutritive value of cereal products conducted at the University of Minnesota by Professor Snyder and at the Maine Agricultural Experiment Station by Prof. Charles D. Woods, and were undertaken under the same general conditions as the other nutrition investigations on the food of man conducted under the auspices of this Office.

Thanks are due to the Oklahoma and Oregon experiment stations for samples of hard and soft winter wheats, and to the North Dakota Experiment Station and the North Dakota Substation for samples of durum wheat; also to the Minnesota Macaroni Company, of St. Paul, for making the macaroni from specially ground wheat.

The results of the investigations with bread of different sorts are in accord with those obtained in former studies, and apparently warrant the belief that it may be laid down as a general rule that bread from fine patent flours is more thoroughly digestible and so has a higher nutritive value than that from the coarse flours ground from the same lots of wheat, although pound for pound it contains somewhat less protein and mineral matter. Furthermore, the investigations confirm the belief that all flours are quite thoroughly digested, and furnish additional proof of the high nutritive value of flour of all grades. The experiments with macaroni indicate that this product is very thoroughly digested, being very similar in this respect to patent flour bread, and that the American product made from native durum wheat is equal in digestibility and food value to European goods.

Respectfully,
A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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DIGESTIBILITY AND NUTRITIVE VALUE OF BREAD AND OF MACARONI.

THE DIGESTIBILITY AND NUTRITIVE VALUE OF BREAD.

INTRODUCTION.

Some years ago it was estimated that the amount of wheat consumed annually in the United States was 4.5 bushels per capita. This would be equivalent to about 200 pounds of flour. Later estimates place the quantity at 6.23 bushels, which would be equal to 277 pounds of flour. Because of its importance no article of food has received more attention from investigators during recent years than flour. In 1897 an extended series of experiments was undertaken at the Maine and the Minnesota experiment stations to determine the digestibility and nutritive value of different grades of flour prepared from the same and from different kinds of wheat. Preceding bulletins of this Office contain accounts of the results of investigations at the Maine[a] and Minnesota[b] stations for 1897 to 1902; similar work at the latter station for 1903-4 is reported herein.

The general plan of these investigations has been to prepare the three common types of flour—Graham, entire-wheat, and standard patent—from the same lot of wheat, and then determine their comparative digestibility and nutritive value by experiments with bread made from the flours. As stated in a former report,[c] Graham flour is unbolted ground wheat; entire-wheat flour contains all of the wheat kernel with the exception of a portion of the bran which is removed with a coarse screen, while the standard patent, or, as hereafter designated, straight-grade, flour contains neither the bran nor the germ, but is fine white flour which has passed through a No. 14 bolting cloth with 193,211 meshes per square inch.

The necessity for confining the comparisons to samples prepared from the same lot of wheat has also been pointed out.[d] It is not possible to compare accurately the nutritive values of the various types of flour when each is prepared from a different lot of wheat, because of the wide variations in composition of different kinds of wheats.

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 85, 143.

[b] U. S. Dept. Agr., Office of Experiment Stations Buls. 67, 101, 126.

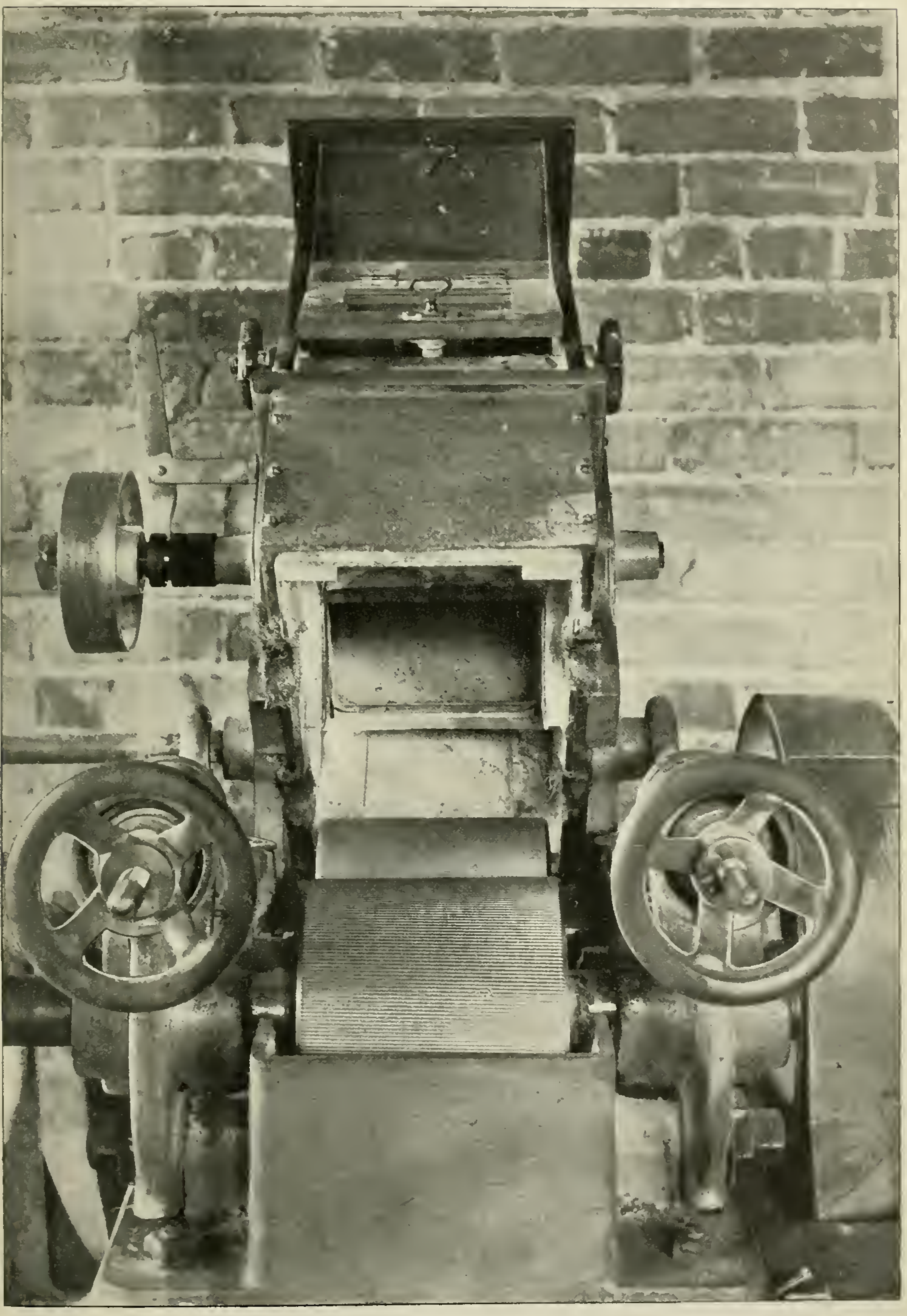
[c] U. S. Dept. Agr., Office of Experiment Stations Bul. 101, p. 8.

[d] U. S. Dept. Agr., Office of Experiment Stations Buls. 101, p. 6; 126, p. 8.

The investigations previously reported have shown that while the coarser flours are somewhat superior as regards the total protein and ash present they are inferior as regards digestibility, and that when these facts are considered together the advantage from the standpoint of nutritive value is with the finer flour. The earlier experiments were made with wheats from widely different localities, including Minnesota northern-grown hard spring wheat, Michigan soft winter wheat, Indiana soft winter wheat, Oklahoma hard winter wheat, and Oregon soft winter wheat, and it seemed important to determine whether similar differences in the composition and digestibility of bread from the different kinds of flour would be noted with flours ground from other types of wheat and whether it was not fair to say that the differences observed were characteristic of all wheats, provided flours were ground from the same sample of grain. The wheats selected for the present investigation were Oklahoma hard winter wheat and Oregon soft winter wheat secured from the Oklahoma and Oregon experiment stations, respectively. These are described in detail beyond (p. 12). Portions of each lot were milled into straight-grade, entire-wheat, and Graham flour, as described below, and the digestibility and nutritive value of each determined from digestion experiments with healthy young men. Furthermore, in order to ascertain the influence on completeness of digestion of the bran and the germ, generally removed in the milling of white flour, samples of bran and of germ were prepared and added to successive samples of Oklahoma straight-grade flour in about the same amounts as were removed during the milling process, and the digestibility and nutritive value of bread from these products likewise determined with the same subjects.

MILLING THE SAMPLES OF WHEAT.

The wheats used in the experiments previously reported were milled in one of the large mills of Minneapolis and in smaller mills in Michigan and Indiana, where somewhat different systems of milling were employed. Although the products of the different systems were of the same general character, samples prepared under uniform conditions afford data for more definite and positive comparisons. Accordingly, in the present investigation, a mill especially devised for experimental purposes, and procured mainly for these experiments, was used. The mill is provided with four sets of rollers, including both corrugated and smooth rollers (illustrated in Plate I), and has the essential features of a patent roller-process mill such as is used in large milling plants. It is supplied with a bolting and sifting attachment and is, in fact, a roller mill in miniature. By its use it is possible



CORRUGATED ROLLERS OF MILL.

to prepare straight-grade, Graham, or entire-wheat flours from a small sample of wheat.

The Oregon and Oklahoma wheats were milled under the supervision of an experienced miller, and the flour was subjected to the inspection of the chief flour inspector of one of the large milling companies of Minneapolis.

The milling was carried on in the usual way.[a] The screened wheat was first passed through corrugated rollers to split the wheat kernel and flatten the germ. As in ordinary milling it was necessary, in grinding the samples, to dampen the wheat so as to prevent the bran from breaking up into fine pieces and contaminating the straight-grade flour. After passing through the second break, small amounts of break flour[b] and granular middlings were separated by means of a fine screen and bolting cloths. The stock was removed from the second break and the tailings passed on to the third break, which resulted in the liberation and reduction of additional quantities of flour and middlings, and then on to the fourth break. With each reduction the rollers were set a little closer. The granular middlings and stock were passed through the smooth rollers three times and finally all brought together. All of the straight-grade flour was passed through a No. 14 bolting cloth (illustrated in Plate II) and thoroughly mixed, the bran, shorts, germ, and other offals being removed at the different boltings from the several breaks.

This process of milling is known as the gradual reduction process. Break flours are first produced and then the granular middlings are liberated from the tailings and bran and reduced. The second break flour is obtained largely from the interior or more floury portions of the wheat kernel and is more starchy in character than later break flours. The third break flour contains a higher percentage of gluten and other proteids than the second break flour. The middlings from the second break are more nitrogenous in character than those from the later breaks. During the process of milling the break flours become more nitrogenous, while the middlings become more starchy in character. The different break flours and middlings, with the exception of a small amount which is separated as second clear or low-grade flour, are finally united, thoroughly mixed and bolted, forming straight-grade flour.

In the milling of these wheats about 70 per cent of the entire wheat was obtained as straight-grade flour. In the large mills, where the offals are subjected to more exhaustive milling, about 72 per cent of straight-grade flour is secured. The milling of the samples in the laboratory under chemical control has proven unusually satisfactory, as it has enabled the different wheats to be milled and the flours prepared on a uniform basis, thus rendering the results more valuable.

---

[a] For a somewhat more detailed account of the milling process, see Minnesota Station Bul. 85, pp. 189, 190.

[b] In each reduction or "break" the "break flour" is the portion passing through the screen and bolting cloths. The "granular middlings" pass through the screen but not the final bolting cloth, and are afterwards reduced to flour. The portion not passing through the screen is known as the "tailings," and passes on to the next "break."

DESCRIPTION OF SAMPLES OF WHEATS AND FLOURS.

A description of the wheats used in this investigation, together with the different grades of flour and milling products made from them, is here given:

No. 269. Oregon white winter wheat weighing 60 pounds per bushel, grown at the Oregon Experiment Station, Corvallis, Oreg. (See Plate III.) Director J. Withycombe, of the Oregon Station, states that this variety of wheat was introduced into western Oregon about sixty years ago by the Hudson Bay Company. It is a wheat with large white plump starchy kernels.

No. 271. Graham flour prepared from Oregon wheat, No. 269. Graham flour is practically wheat meal and consists of the entire wheat kernel, including bran, germ, and offal. As no sieves or bolting cloths are used in its preparation, there are many coarse unpulverized particles present in the product.

No. 272. Entire-wheat flour from Oregon wheat, No. 269. Entire-wheat flour is prepared by removing the larger portion of the coarse bran, while the fine bran, or shorts, and germ are retained in the flour. This was done by the use of coarse wire screens. The flour was subjected to two breaks on the coarse and two on the smooth rollers. Entire-wheat flour is of finer granulation than Graham, but much coarser than straight-grade flour.

No. 273. Straight-grade flour from Oregon wheat, No. 269. The grain was run through three coarse rollers three times, the flour being taken out at each break. The middlings were passed through three smooth rollers three times and the flour removed each time. The bran was fairly free from flour. About 70 per cent of the wheat was recovered as straight-grade flour.

No. 270. Hard winter Weissenburg wheat weighing 62 pounds per bushel, grown at the Oklahoma Experiment Station, Stillwater, Okla. (see Plate III). Director J. Fields states that the original seed was obtained through W. T. Swingle, of the U. S. Department of Agriculture, and was designated No. 3821. This sample is characteristic of the winter wheat grown in that locality, and in yield compares very favorably with other leading varieties. The kernels were of medium size, amber color, and glutinous character.

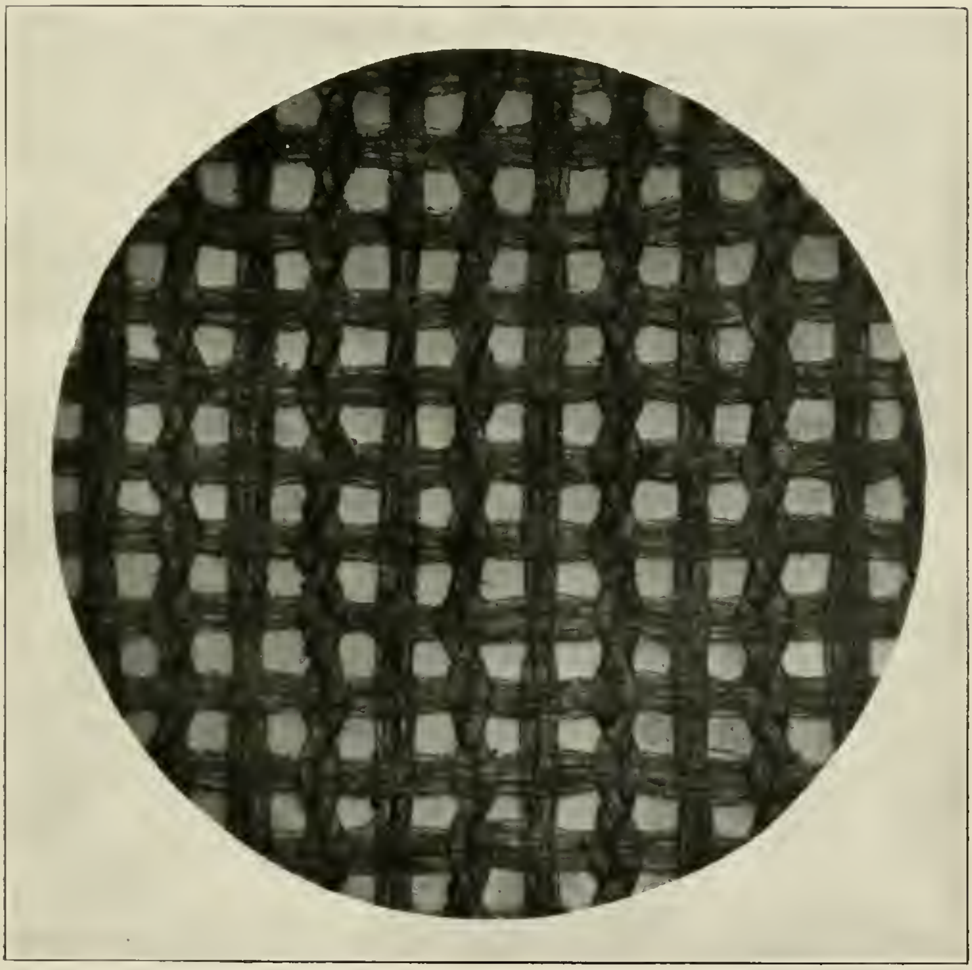
No. 274. Graham flour from Oklahoma wheat, No. 270. This was prepared in the same way as No. 271.

No. 275. Entire-wheat flour from Oklahoma wheat, No. 270. This was prepared in a manner similar to No. 272, and 86 per cent of the wheat was recovered as entire-wheat flour.

No. 276. Straight-grade flour from Oklahoma wheat, No. 270. This was prepared in the same way as No. 273. About 70 per cent of straight-grade flour was recovered.

No. 413. Bran from Oklahoma wheat, No. 270. Bran consists of the coarsely ground episperm or outer covering of the wheat kernel. The sample was ground in a burr mill and then in a Maerker mill.

No. 414. Germ from Oklahoma wheat, No. 270. The germ is the undeveloped plumule. In the process of straight-grade flour making it is excluded, because, as it is fermentable in character, it impairs the keeping qualities of the flour and pro-



BOLTING CLOTH NO. 14 (MAGNIFIED 48 DIAMETERS) THROUGH WHICH THE STRAIGHT-GRADE FLOUR WAS PASSED.

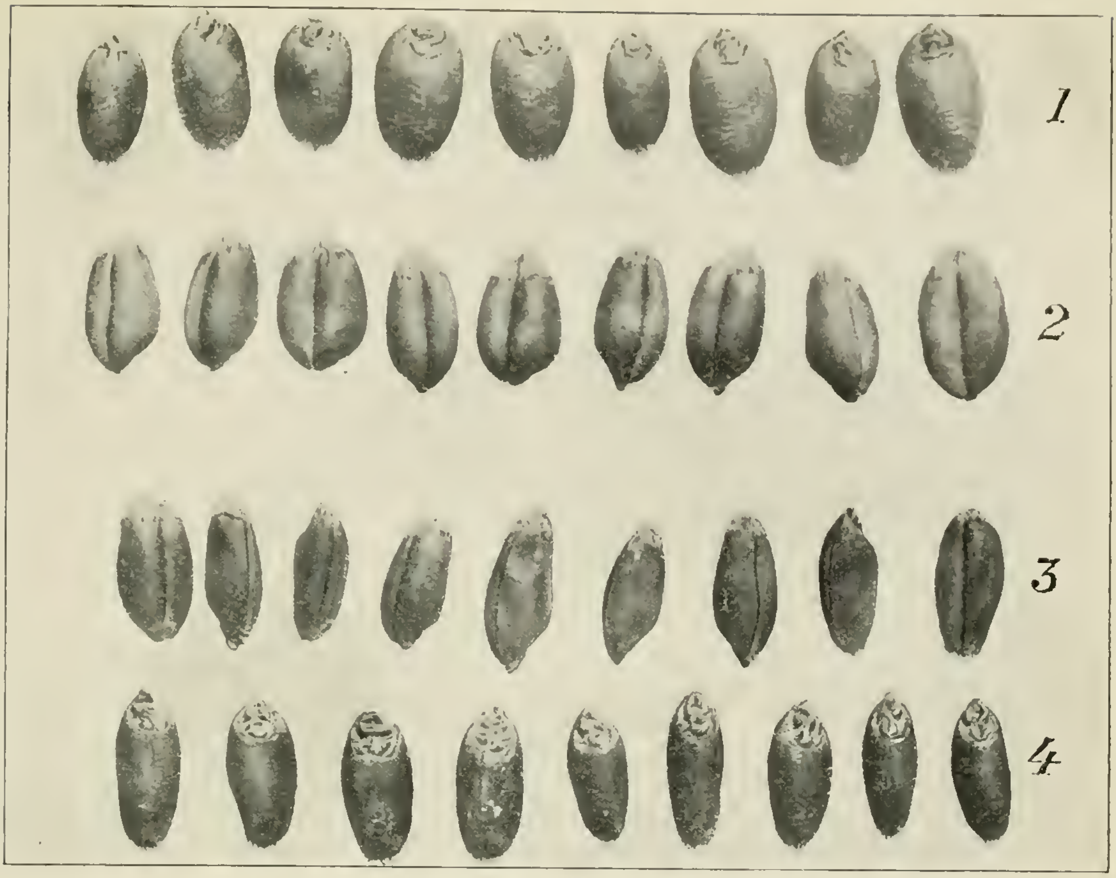


FIG. 1.—OREGON AND OKLAHOMA WHEATS.

Rows 1 and 2, Oregon white winter wheat from sample No. 269, containing 9.12 per cent protein. Rows 3 and 4, Oklahoma winter wheat from sample No. 270, containing 16.82 per cent protein.

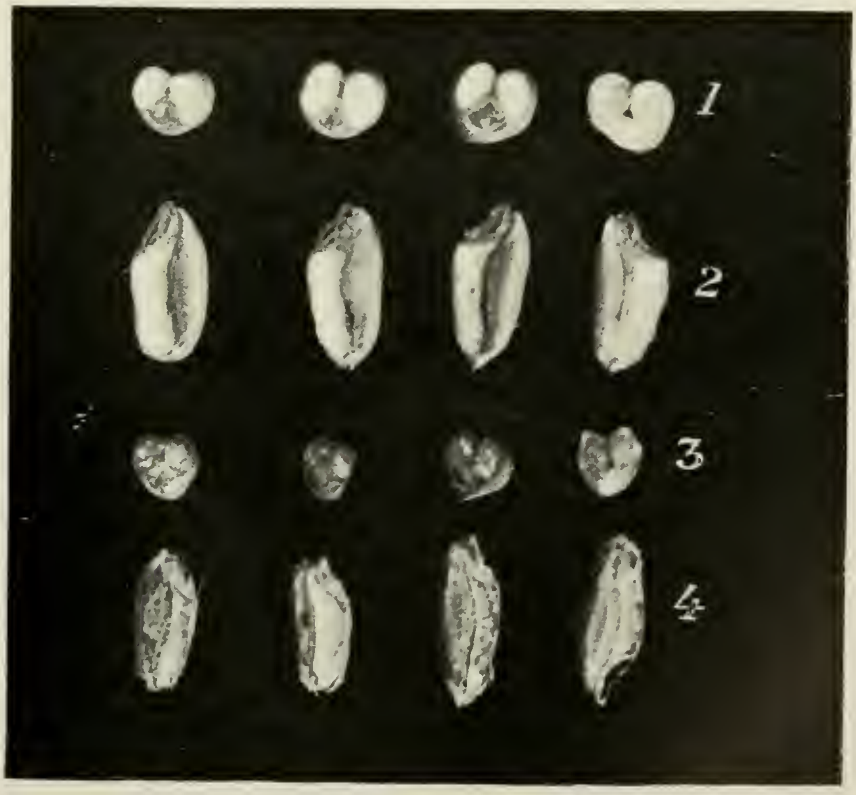


FIG. 2.—OREGON AND OKLAHOMA WHEATS.

Rows 1 and 2, sections of Oregon white winter wheat. Rows 3 and 4, sections of Oklahoma winter wheat.

duces an inferior quality of bread. The sample was ground in the same way as the bran.

No. 415. Bran flour. The sample was prepared by adding 14 per cent of finely ground bran (No. 413) to the straight-grade Oklahoma flour (No. 276).

No. 416. Germ flour. The sample was prepared by mixing 93 per cent of straight-grade Oklahoma flour (No. 276) with 7 per cent of finely ground germ (No. 414).

COMPOSITION OF SAMPLES OF WHEATS AND FLOURS.

Complete proximate analyses of all of the wheat and flour samples were made according to the methods recommended by the Association of Official Agricultural Chemists.[a] The protein content was calculated by the use of two factors, namely, 5.7 and 6.25. Investigations have shown that the principal wheat proteids contain about 17.6 per cent nitrogen instead of 16 per cent, the value upon which the factor 6.25 is based, which is commonly used for calculating protein from nitrogen. The use of the factor 5.7 gives lower values for the protein, but the results undoubtedly represent more nearly the actual amount in the wheat than that obtained by the factor 6.25. However, for the sake of comparison with investigations previously reported in which the factor 6.25 was used, the protein is also computed by the use of this factor. The carbohydrates determined by difference are also estimated on the basis of protein as computed by both factors. The heat of combustion was determined by combustion in a Berthelot-Atwater bomb calorimeter, as described in a former publication.[b] In the case of the milk samples weighed blocks of cellulose were employed to absorb the liquid, according to the method described in a former report.[c] The calculated heats of combustion of the wheat and flour samples were obtained by the use of the following factors: Protein, 5.9; fat, 9.3; and carbohydrates, 4.2 calories per gram. Earlier investigations have shown that when the principal nutrients of wheat flour were separated, purified, and burned in the calorimeter they yielded the following values per gram: Wheat starch 4.190 calories, wheat fat 9.282 calories, gliadin 5.924 calories, and glutenin 5.879[d] calories. The calculated and determined heats of combustion of the flour samples agree quite closely, though the agreement is not perfect because of the presence of cellulose and other substances which have a factor for heat of combustion different from that used in the calculation.

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[a] U. S. Dept. Agr., Division of Chemistry Bul. 46, revised edition.

[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 101, p. 10.

[c] U. S. Dept. Agr., Office of Experiment Stations Bul. 126, p. 9.

[d] U. S. Dept. Agr., Office of Experiment Stations Bul, 101, p. 13.

TABLE 1.—*Composition and heat of combustion of wheats and flours.*

Sample number.	Kind of material.	Water.	Protein.		Fat.	Carbohydrates when protein is estimated as—		Ash.	Heat of combustion per gram.	
			(N × 6.25)	(N × 5.7).		N × 6.25.	N × 5.7.		Calculated.	Determined.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*	*Calories.*
269	Oregon wheat...	8.99	9.12	8.32	1.83	78.30	79.10	1.76	3.997	4.008
271	Graham flour from No. 269...	8.15	8.97	8.18	1.68	79.48	80.27	1.72	4.023	3.990
272	Entire-wheat flour from No. 269	8.66	8.25	7.52	1.67	80.35	81.08	1.07	4.016	3.900
273	Straight-grade flour from No. 269	8.94	7.55	6.90	1.25	81.82	82.47	.44	3.998	3.880
270	Oklahoma wheat.........	8.65	16.82	15.33	1.83	71.38	72.87	1.32	4.160	4.110
274	Graham flour from No. 270...	7.73	16.81	15.33	1.79	72.35	73.83	1.32	4.196	4.178
275	Entire-wheat flour from No. 270	7.46	16.63	15.16	1.64	73.05	74.52	1.22	4.201	4.159
276	Straight-grade flour from No. 270	9.93	15.06	13.74	.92	73.57	74.89	.52	4.065	4.040
413	Bran	9.91	16.39	14.93	4.50	62.79	64.25	6.41	4.022	4.103
414	Germ	8.73	29.88	27.24	11.23	45.45	48.09	4.71	4.716	4.597
415	Bran flour.......	9.69	15.35	13.96	1.48	72.23	73.62	1.25	4.077	3.876
416	Germ flour......	9.63	16.30	14.87	1.66	71.54	72.97	.87	4.124	3.962

Table 1 illustrates the fact that different wheats and different types of flour vary widely in composition. Thus, straight-grade flour (No. 276) prepared from Oklahoma wheat contained a much larger amount of protein than Graham flour (No. 271) prepared from Oregon wheat. This emphasizes the importance, previously pointed out, of preparing the different kinds of flour for investigations of this nature from the same lot of wheat. Otherwise, if a straight-grade flour milled from one lot of wheat were compared with an entire-wheat flour milled from another and entirely different lot of wheat, the straight-grade flour might contain either more or less starch or protein than the Graham flour, according to the character of the wheats from which they were prepared. From the data in Table 1 it will be observed, however, that for both the Oregon and Oklahoma wheats the Graham flour contained more protein and fat and less carbohydrates than the entire-wheat flour, which in turn contained more protein and fat and less carbohydrates than the straight-grade flour.

It will be observed from this table that the Oregon and Oklahoma wheats and flours were decidedly unlike in character. The Oregon wheat (sample No. 269) was starchy and characterized by a low protein content, while the Oklahoma wheat (No. 270) was glutinous in character and contained a high percentage of protein. The straight-grade flour from the Oregon wheat contained 1.47 per cent of total nitrogen, 70.1 per cent of the proteids being in the form of gliadin soluble in 70 per cent alcohol, while the straight-grade flour from the Oklahoma wheat contained 2.41 per cent total nitrogen, of which 59.75 per cent was in the form of gliadin.

As pointed out in a former report[a] the ash content varies so regularly in different grades of milling products that it is possible to determine the grade of flour by determining the amount of ash which it contains. In these samples the ash content of the flour sample agrees closely with that known to be present in standard grades of straight-grade, entire-wheat, and Graham flour.

COMPOSITION OF SAMPLES OF FOOD MATERIALS.

The table below gives the data regarding the composition of the foods consumed in the digestion experiments. The values given in each case are the result of actual analysis, except that the percentage of fat in the dry matter of the flour is used as a basis in the calculations for the fat content of bread. The results thus obtained are known to be more accurate than those secured from the analysis of the bread, because during the process of bread making the fat of the flour is in part rendered insoluble.[b]

A sample of 100 grams from each loaf of bread used was dried and a composite sample for analysis was then taken proportional to the weight of the loaves and the quantity consumed. This has been found to be the most satisfactory method of sampling and preparing bread for analysis. A composite sample of milk was made for each of the digestion trials by reserving 25 cubic centimeters of the mixed milk taken at each meal, 100 milligrams of potassium bichromate being used as a preservative.

TABLE 2.—*Composition of bread and milk used in digestion experiments with Oregon and Oklahoma wheat breads.*

Sample No.	Kind of material.	Water.	Protein (N × 6.25).[c]	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
	Bread made from:	*Per ct.*	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
277	Oregon entire-wheat flour	39.95	5.70	[d]1.09	52.39	0.87	2.566
294	Oregon straight-grade flour	34.95	5.41	[d].89	57.85	.90	2.765
311	Oregon Graham flour	38.55	6.11	[d]1.12	52.68	1.54	2.562
328	Oklahoma straight-grade flour	37.65	10.13	[d].64	51.14	.44	2.783
345	Oklahoma entire-wheat flour	41.31	10.60	[d]1.04	46.11	.94	2.714
362	Oklahoma Graham flour	42.20	10.65	[d]1.12	44.58	1.45	2.516
379	Straight-grade flour with 14% bran	43.20	9.50	[d].84	45.55	.91	2.499
396	Straight-grade flour with 7% germ	38.00	11.07	[d]1.13	49.12	.68	2.793
278	Milk, composite sample	88.34	3.62	3.58	3.77	.69	.613
295	do	87.28	2.96	4.46	4.46	.84	.765
312	do	87.74	1.77	4.36	5.33	.80	.681
329	do	87.92	2.90	3.69	4.66	.83	.643
346	do	87.53	2.87	4.30	4.60	.70	.709
363	do	86.88	2.94	5.86	3.45	.87	.690
380	do	86.95	3.49	4.93	3.60	[e]1.03	.800
397	do	86.83	3.05	4.35	5.02	.75	.750

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 101, p. 9.

[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 67, p. 45.

[c] For explanation of the use of the factor 6.25 for calculation of protein in bread see p. 18.

[d] Fat content of dry matter of flour.

[e] High ash due to abnormal amount of preservative used in composite sample.

COMPOSITION OF FECES AND URINE.

The feces for the experimental period were collected and analyzed by the usual methods. The separations of the feces at the beginning and end of each period were effected by means of charcoal in gelatin capsules as a marker.[a] The data regarding the composition of the feces are here tabulated.

TABLE 3.—*Composition of dry matter of feces from digestion experiments with Oregon and Oklahoma wheat bread.*

Sample No	Whence obtained.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
291	Experiment No. 469	25.90	12.78	38.40	22.92	4.500
292	Experiment No. 470	24.05	9.27	45.80	20.88	4.457
293	Experiment No. 471	25.26	11.26	41.75	21.73	4.500
308	Experiment No. 472	23.95	12.64	31.59	31.82	4.619
309	Experiment No. 473	25.37	11.32	27.89	35.42	3.960
310	Experiment No. 474	29.22	9.97	33.36	27.45	4.229
325	Experiment No. 475	22.41	11.21	48.53	17.85	4.578
326	Experiment No. 476	21.57	10.48	48.44	19.51	4.295
327	Experiment No. 477	32.52	11.87	36.52	19.09	4.438
342	Experiment No. 478	24.88	9.32	39.12	26.68	4.830
343	Experiment No. 479	28.97	7.71	31.98	31.34	4.124
344	Experiment No. 480	29.17	13.82	29.80	27.21	4.261
359	Experiment No. 481	27.77	6.69	49.55	15.99	4.804
360	Experiment No. 482	24.36	7.43	50.31	17.90	4.447
361	Experiment No. 483	23.87	10.37	45.20	20.56	4.510
376	Experiment No. 484	22.85	10.13	49.93	17.09	4.726
377	Experiment No. 485	22.46	8.51	52.97	16.06	3.282
378	Experiment No. 486	23.54	11.53	46.60	18.33	4.452
393	Experiment No. 487	23.90	13.33	41.05	21.72	4.510
394	Experiment No. 488	22.64	9.98	43.73	23.65	4.200
395	Experiment No. 489	22.30	7.18	48.08	22.44	4.930
410	Experiment No. 490	30.27	10.83	32.45	26.45	4.874
411	Experiment No. 491	29.18	10.38	31.11	29.33	4.330
412	Experiment No. 492	27.94	16.19	30.29	25.58	4.520

The urine of each subject was collected during each experimental period, beginning with 7 a. m. of the first day of the experiment and ending at 7 a. m. of the first day immediately following the experiment. The total amount and specific gravity of the urine and the percentage of nitrogen in it were determined for each day. These data are here given:

TABLE 4.—*Amount, specific gravity, and nitrogen of urine from digestion experiments with Oregon and Oklahoma wheat bread.*

Sample No.	Subject No.	Whence obtained.	Total amount voided.	Specific gravity.	Nitrogen
		Experiment No. 469:	*Grams.*		*Per cent.*
279	1	First day	1,119	1.023	1.30
282	1	Second day	972	1.025	1.45
285	1	Third day	685	1.029	1.90
288	1	Fourth day	1,759	1.018	1.21
		Experiment No. 470:			
280	2	First day	747	1.027	1.45
283	2	Second day	730	1.030	1.79
286	2	Third day	515	1.030	1.96
289	2	Fourth day	1.014	1.027	1.84

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 21, p. 58, 143, pp. 66-76.

TABLE 4.—*Amount, specific gravity, and nitrogen of urine from digestion experiments with Oregon and Oklahoma wheat bread*—Continued.

Sample No.	Subject No.	Whence obtained.	Total amount voided.	Specific gravity.	Nitrogen.
		Experiment No. 471:	*Grams.*		*Per cent.*
281	3	First day	464	1.029	1.55
284	3	Second day	728	1.032	1.85
287	3	Third day	697	1.025	1.62
290	3	Fourth day	965	1.026	1.64
		Experiment No. 472:			
296	1	First day	1,386	1.020	1.31
299	1	Second day	979	1.025	1.49
302	1	Third day	1,066	1.023	1.55
305	1	Fourth day	1,775	1.020	1.26
		Experiment No. 473:			
297	2	First day	888	1.023	1.24
300	2	Second day	1,398	1.015	.95
303	2	Third day	638	1.025	1.56
306	2	Fourth day	1,196	1.029	1.24
		Experiment No. 474:			
298	3	First day	948	1.018	1.11
301	3	Second day	774	1.022	1.21
304	3	Third day	1,252	1.021	1.24
307	3	Fourth day	1,314	1.020	1.24
		Experiment No. 475:			
313	1	First day	691	1.023	1.38
316	1	Second day	876	1.027	1.42
319	1	Third day	911	1.029	1.46
322	1	Fourth day	1,533	1.028	1.52
		Experiment No. 476:			
314	2	First day	613	1.028	1.37
317	2	Second day	794	1.027	1.66
320	2	Third day	689	1.026	1.44
323	2	Fourth day	1,505	1.025	1.19
		Experiment No. 477:			
315	3	First day	743	1.025	1.44
318	3	Second day	714	1.027	1.42
321	3	Third day	857	1.029	1.69
324	3	Fourth day	1,188	1.020	1.20
		Experiment No. 478:			
330	1	First day	1,327	1.024	1.53
333	1	Second day	1,592	1.026	1.60
336	1	Third day	1,891	1.022	1.56
339	1	Fourth day	2,361	1.022	1.52
		Experiment No. 479:			
331	2	First day	989	1.027	1.60
334	2	Second day	878	1.030	1.93
337	2	Third day	892	1.029	1.96
340	2	Fourth day	2,236	1.019	1.32
		Experiment No. 480:			
332	3	First day	1,103	1.022	1.26
335	3	Second day	1,114	1.020	1.37
338	3	Third day	1,148	1.023	1.50
341	3	Fourth day	1,193	1.022	1.44
		Experiment No. 481:			
347	1	First day	1,220	1.023	1.29
350	1	Second day	1,250	1.027	1.63
353	1	Third day	1,395	1.027	1.76
356	1	Fourth day	2,165	1.025	1.66
		Experiment No. 482:			
348	2	First day	839	1.029	1.48
351	2	Second day	726	1.027	1.86
354	2	Third day	727	1.029	1.77
357	2	Fourth day	1,312	1.030	2.17
		Experiment No. 483:			
349	3	First day	2,079	1.015	.55
352	3	Second day	1,749	1.018	.98
355	3	Third day	1,352	1.019	1.18
358	3	Fourth day	1,086	1.023	1.44
		Experiment No. 484:			
364	1	First day	1,841	1.021	1.15
367	1	Second day	1,440	1.025	1.48
370	1	Third day	1,520	1.025	1.54
373	1	Fourth day	2,582	1.023	1.61
		Experiment No. 485:			
365	2	First day	944	1.026	1.53
368	2	Second day	1,102	1.029	1.85
371	2	Third day	801	1.027	1.96
374	2	Fourth day	781	1.029	1.92
		Experiment No. 486:			
366	3	First day	1,327	1.018	1.02
369	3	Second day	1,336	1.019	1.06
372	3	Third day	1,040	1.022	1.31
375	3	Fourth day	1,217	1.021	1.37

TABLE 4.—*Amount, specific gravity, and nitrogen of urine from digestion experiments with Oregon and Oklahoma wheat bread*—Continued.

Sample No.	Subject No.	Whence obtained.	Total amount voided.	Specific gravity.	Nitrogen.
			Grams.		*Per cent.*
		Experiment No. 487:			
381	1	First day	1,195	[a]1.026	[a]1.47
384	1	Second day	1,354		
387	1	Third day	1,924		
		Experiment No. 488:			
382	2	First day	745	[a]1.028	[a]2.08
385	2	Second day	804		
388	2	Third day	1,467		
		Experiment No. 489:			
383	3	First day	1,099	[a]1.024	[a]1.57
386	3	Second day	1,203		
389	3	Third day	721		
		Experiment No. 490:			
398	1	First day	1,518	[a]1.026	[a]1.62
401	1	Second day	1,612		
404	1	Third day	1,753		
		Experiment No. 491:			
399	2	First day	507	[a]1.028	[a]1.81
402	2	Second day	1,049		
405	2	Third day	1,042		
		Experiment No. 492:			
400	3	First day	1,060	[a]1.023	[a]1.46
403	3	Second day	1,070		
406	3	Third day	1,412		

[a] Composite sample.

EXPERIMENTAL METHODS.

The method followed in making the digestion experiments was similar to that explained in detail in a former bulletin.[a] A simple diet of bread and milk was eaten, each material being consumed ad libitum, but the amount taken at each meal weighed and recorded. The digestibility of the nutrients of the total diet was determined from the quantity of each in the food and feces. The digestibility of the nutrients in the bread alone was computed by assuming coefficients of digestibility for the nutrients of the milk, as explained beyond.

The bread was made by the short process of fermentation—that is, with a large proportion of yeast. Comparatively large amounts of salt and water were used in mixing the dough, but neither milk nor shortening. For each experiment two bakings were made, the subjects preferring bread twenty-four hours old to fresh bread.

The digestibility of the total diet of bread and milk was calculated from the difference between the total nutrients in the food consumed and those in the feces.[b] The digestibility of the bread alone was calculated, as in former work, by assuming that 97 per cent of the protein, 95 per cent of the fat, and 98 per cent of the carbohydrates of the milk were digested. These values have been deduced from the results of a large number of digestion experiments with both ordinary and special diets.[a] The undigested nutrients of the milk, as calculated by the use of these factors, subtracted from the total nutrients in the feces give the estimated undigested nutrients from bread, and these subtracted from the total nutrients of the bread give the digestible nutrients in bread. These last divided by the total nutrients in the bread and multiplied by 100 give the percentages or coefficients of digestibility of bread alone.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 85.

[b] It will be observed that, although the factor 5.70 is more nearly correct for the calculation of the percentage of protein in cereals from the percentage of nitrogen determined, the factor 6.25 has been used in these experiments. The same factor has been used for milk protein, in which case it is correct. The use of this factor for cereals also is merely for convenience in the computations of the digestibility of the protein. If different factors were used for the protein of different foods, the same differences in factors would have to be observed in estimating protein of feces, and this would involve complicated computations. Since the coefficient of digestibility would be the same whichever factor is used, provided the same factor is used for protein of both food and feces, the factor 6.25 has been used uniformly for convenience.

The amounts of energy given for the bread and milk and the total feces were determined by multiplying the total weight of each material by its heat of combustion as determined with the bomb calorimeter. The proportion of energy in total food estimated to be available to the body was found by dividing the energy of the total digested food by the energy of the total food.

In order to estimate the amounts of energy in the feces from bread alone, the energy of the feces from food other than bread (in this case milk) was computed by means of factors. Previous investigations[b] have shown that the heat of combustion of the nutrients in dairy products are, per gram, as follows: For protein, 5.65 calories; for fat, 9.25 calories; and for carbohydrates, 3.9 calories. By multiplying the weights of the nutrients in the feces from food other than bread by these factors and adding the products an estimated energy value is obtained. It is known, however, as pointed out on page 13, that the energy of food materials, when estimated by the use of factors, varies somewhat from the value obtained by actual combustion in the bomb calorimeter. A similar variation is found in the total feces, and undoubtedly would be found in the feces from a portion of the diet could a separation be effected and the actual heat of combustion determined. In order to approximate this latter value as closely as possible, the energy of the total feces was also calculated by means of factors. In this case, however, since the total feces were made up of the residues from two foods—milk and bread—the factors used were those computed[b] for a mixed diet, these values being per gram as follows: Protein, 5.65 calories; fat, 9.4 calories, and carbohydrates, 4.15 calories. It was then assumed that the difference in values existing between the energy of the total feces as thus computed and as actually determined is proportional to the presumed difference in value between the energy of the feces from food other than bread as computed and the value which would be obtained could an actual determination be made. In other words, the calculated energy of the total feces is to the determined energy of the total feces as the calculated energy of the feces from food other than bread is to x, the value desired. For example, in experiment No. 469 the computed heat of combustion of the total feces was 745 calories, while the value obtained in the calorimeter was 787 calories. The computed heat of combustion of the feces from food other than bread was 242 calories. The proportion was therefore as follows: $745:787=242:x$, or $x=257$ calories. The heat of combustion of the feces from bread alone was found by subtracting this value from the determined heat of combustion of the total feces (787 calories). This result (530 calories) subtracted from the total heat of combustion of bread (4,770 calories) gives the heat of combustion of the estimated digestible nutrients in bread (4,240 calories), which divided by the total heat of combustion of bread (4,770 calories) and multiplied by 100 gives the proportion (88.9 per cent) of the total energy of the bread estimated to be contained in the digestible nutrients.

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[a] Connecticut Storrs Station Rpt. 1899, pp. 84–86.

[b] Connecticut Storrs Station Rpt. 1899, p. 104.

The value as thus determined, however, does not represent the energy actually available to the body, since a portion of the energy of the digested nutrients is lost in the incompletely oxidized material of the urine. The proportion of the energy of the total food and of the bread alone which was actually available to the body was computed as in previous investigations, according to the assumption that the amount of the energy lost in the organic matter of the urine was 1.25 calories per gram of digestible protein. Thus in experiment No. 469 the total amount of energy lost in the urine was found by multiplying the digestible protein in total food (401.4 grams) by 1.25, which gave 502 calories. This product was subtracted from the energy of the total food digested (9,756 calories), and the difference (9,254 calories) divided by the energy in the total food (10,543 calories) and multiplied by 100 gave the proportion of energy in the total food actually available to the body (87.8 per cent). The proportion of energy in bread alone which was actually available (87 per cent) was obtained in like manner by dividing the difference between the estimated energy in the bread digested (4,240 calories) and the energy lost in the urine ($70.9\times1.25=89$ calories) by the total energy in the bread (4,770 calories).

As pointed out in former reports, it is well known that the digestion coefficients obtained in the manner described are relative rather than absolute. It is believed, however, that while the figures for a single digestion experiment may be open to criticism, the results of a series of experiments as reported in this bulletin are comparable because whatever error is introduced in one experiment is common to all. Since the determinations of dry matter, nitrogen, and energy are known to be of greater accuracy than the other chemical data included, particular attention is given to the results and conclusions based upon these values.

DETAILS OF THE DIGESTION EXPERIMENTS.

In these investigations with Oregon and Oklahoma wheats two series of digestion experiments were carried on, each series consisting of three experiments with each of three subjects. The diet consisted of milk, and bread made from the different grades of flour. In the first series the first three experiments were carried on simultaneously, the three subjects being fed on bread from the entire-wheat flour milled from the Oregon wheat, and in addition sufficient milk to make the diet palatable. Three more experiments followed in which bread from the straight-grade flour was substituted for the entire-wheat bread, and, finally, in three more experiments Graham bread was used. In the second series the experiments were repeated in a similar way with bread made from the Oklahoma wheat.

Besides these, two additional experiments were made with each subject in order to determine the influence of the bran and germ upon the completeness of digestion. In the first of these the diet consisted of bread from bran flour, eaten with some milk. In the second, bread from germ flour was substituted for the bran flour bread.

The total number of separate experiments was therefore twenty-four. The period of duration in each of the experiments with the ordinary flours was four days, or twelve meals; in the experiments with the bran and germ flour breads it was three days, or nine meals.

The subjects, designated in these experiments as Nos. 1, 2, and 3, were young men in good health. One was employed as a laborer on the university farm at field work and the care of stock, and the other two devoted part of their time to university studies with several hours each day of miscellaneous muscular work.

EXPERIMENTS WITH ENTIRE-WHEAT, STRAIGHT-GRADE, AND GRAHAM FLOURS (BREAD) FROM OREGON WHEAT.

The following tables, Nos. 5 to 13, give the data of the nine experiments in the series with Oregon wheat. Accompanying each table are statistics regarding the diet, subject, and date of the experiment, and a summary of the data of income and outgo of nitrogen during the experimental period.

DIGESTION EXPERIMENT NO. 469.

Kind of food.—Milk, and bread made from Oregon entire-wheat flour.

Subject.—Man No. 1. Farm hand employed at average farm labor.

Weight.—At the beginning of the experiment 180 pounds; at the close 180 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast, March 11, 1903.

TABLE 5.—*Results of digestion experiment No. 469.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
277	Bread	1,859.0	106.0	20.3	973.9	16.2	4,770
278	Milk	9,412.0	340.7	336.9	354.8	64.9	5,773
	Total	....	446.7	357.2	1,328.7	81.1	10,543
291	Feces (water-free)	175.0	45.3	22.4	67.2	40.1	787
	Estimated feces from food other than bread	....	10.2	16.9	7.1	....	257
	Estimated feces from bread	....	35.1	....	60.1	....	530
	Total amount digested	....	401.4	334.8	1,261.5	41.0	9,756
	Estimated digestible nutrients in bread	....	70.9	....	913.8	....	4,240
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	89.8	93.7	91.9	50.6	92.5
	Estimated coefficients of digestibility of bread alone	....	66.9	....	93.8	....	88.9
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	87.8
	In bread alone	....	....	....	....	....	87.0

During this experiment the subject eliminated 4,535 grams urine, containing 62.94 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 17.87 grams; outgo in urine 15.74 grams; and in feces 1.81 grams; implying a gain of 0.32 gram nitrogen, corresponding to 2 grams protein.

DIGESTION EXPERIMENT NO. 470.

Kind of food.—Milk, and bread made from Oregon entire-wheat flour.

Subject.—Man No. 2. University student employed about two hours per day at miscellaneous manual labor; walked about 2 miles daily.

Weight.—At the beginning of the experiment 159.25 pounds; at the close 158.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 11, 1903.

TABLE 6.—*Results of digestion experiment No. 470.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
277	Bread	2,623.0	149.5	28.6	1,374.2	22.8	6,731
278	Milk	7,998.0	289.5	286.3	301.5	55.2	4,906
	Total	....	439.0	314.9	1,675.7	78.0	11,637
292	Feces (water-free)	176.0	42.3	16.3	80.6	36.8	785
	Estimated feces from food other than bread	....	8.7	14.3	6.0	....	221
	Estimated feces from bread	....	33.6	....	74.6	....	564
	Total amount digested	....	396.7	298.6	1,595.1	41.2	10,852
	Estimated digestible nutrients in bread	....	115.9	....	1,299.6	....	6,167

TABLE 6.—*Results of digestion experiment No. 470*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	90.4	94.8	95.2	52.9	(93.3)
	Estimated coefficients of digestibility of bread alone	....	77.5	....	91.6	....	(91.6)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	89.0
	In bread alone	....	....	....	....	....	89.5

During this experiment the subject eliminated 3,006 grams urine containing 52.65 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 17.56 grams; outgo in urine 13.16 grams; and in feces 1.69 grams; implying a gain of 2.71 grams nitrogen, corresponding to 16.9 grams protein.

DIGESTION EXPERIMENT NO. 471.

Kind of food.—Milk, and bread made from Oregon entire-wheat flour.

Subject.—Man No. 3. University student employed one-third of the time at office work, with exercise the same as subject No. 2.

Weight.—At the beginning of the experiment 158 pounds; at the close 155 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 11, 1903.

TABLE 7.—*Results of digestion experiment No. 471.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
277	Bread	1,811.0	103.2	19.7	948.8	15.8	4,647
278	Milk	5,302.4	192.0	189.8	199.9	36.6	3,253
	Total	....	295.2	209.5	1,148.7	52.4	7,900
293	Feces (water-free)	150.0	37.9	16.9	62.6	32.6	675
	Estimated feces from food other than bread	....	5.8	9.5	4.0	....	147
	Estimated feces from bread	....	32.1	....	58.6	....	528
	Total amount digested	....	257.3	192.6	1,086.1	19.8	7,225
	Estimated digestible nutrients in bread	....	71.1	....	890.2	....	4,119
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	87.2	91.9	94.6	37.7	(91.5)
	Estimated coefficients of digestibility of bread alone	....	68.9	....	93.8	....	(88.6)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	87.4
	In bread alone	....	....	....	....	....	86.7

During this experiment the subject eliminated 2,854 grams urine, containing 47.79 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 11.81 grams; outgo in urine 11.95 grams; and in feces 1.52 grams; implying a loss of 1.66 grams nitrogen, corresponding to 10.4 grams protein.

DIGESTION EXPERIMENT NO. 472.

Kind of food.—Milk, and bread made from Oregon straight-grade flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 174.5 pounds; at the close 174 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 26, 1903.

TABLE 8.—*Results of digestion experiment No. 472.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
294	Bread	2,514.0	137.6	22.6	1,471.7	22.9	7,034
295	Milk	9,153.8	271.0	408.3	408.3	76.9	7,003
	Total	....	408.6	430.9	1,880.0	99.8	14,037
308	Feces (water-free)	117.0	28.0	14.8	37.0	37.2	540
	Estimated feces from food other than bread	....	8.1	20.4	8.2	....	320
	Estimated feces from bread	....	19.9	....	28.8	....	220
	Total amount digested	....	380.6	416.1	1,843.0	62.6	13,497
	Estimated digestible nutrients in bread	....	117.7	....	1,442.9	....	6,814
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	93.1	96.6	98.0	62.7	(96.2)
	Estimated coefficients of digestibility of bread alone	....	85.6	....	98.0	....	(96.9)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	92.8
	In bread alone	....	....	....	....	....	94.8

During this experiment the subject eliminated 5,206 grams urine, containing 71.64 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 16.34 grams; outgo in urine 17.91 grams; and in feces 1.12 grams; implying a loss of 2.69 grams nitrogen, corresponding to 16.8 grams protein.

DIGESTION EXPERIMENT NO. 473.

Kind of food.—Milk, and bread made from Oregon straight-grade flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 152.5 pounds; at the close 154 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 26, 1903.

TABLE 9.—*Results of digestion experiment No. 473.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
294	Bread	3,045.0	164.7	27.1	1,761.5	27.4	8,419
295	Milk	8,034.0	237.8	358.3	358.3	67.5	6,147
	Total		402.5	385.4	2,119.8	94.9	14,566
309	Feces (water-free)	97.0	24.6	11.0	27.0	34.4	384
	Estimated feces from food other than bread		7.1	17.9	7.2		255
	Estimated feces from bread		17.5		19.8		129
	Total amount digested		377.9	374.4	2,092.8	60.5	14,182
	Estimated digestible nutrients in bread		147.2		1,741.7		8,290
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		93.9	97.2	98.7	63.8	(97.4)
	Estimated coefficients of digestibility of bread alone		89.4		98.9		(98.5)
	Proportion of energy actually available to the body:						
	In total food						94.1
	In bread alone						96.3

During this experiment the subject eliminated 4,120 grams urine, containing 49.07 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 16.10 grams; outgo in urine 12.27 grams; and in feces 0.98 gram; implying a gain of 2.85 grams nitrogen, corresponding to 17.8 grams protein.

DIGESTION EXPERIMENT NO. 474.

Kind of food.—Milk, and bread made from Oregon straight-grade flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 155 pounds; at the close 155.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 26, 1903.

TABLE 10.—*Results of digestion experiment No. 474.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
294	Bread	2,463.0	133.2	21.9	1,424.8	22.2	6,810
295	Milk	6,192.0	183.3	276.2	276.2	52.0	4,737
	Total		316.5	298.1	1,701.0	74.2	11,547
310	Feces (water-free)	111.0	32.4	11.1	37.0	30.5	469
	Estimated feces from food other than bread		5.5	13.8	5.5		192
	Estimated feces from bread		26.9		31.5		277
	Total amount digested		284.1	287.0	1,664.0	43.7	11,078

TABLE 10.—*Results of digestion experiment No. 474*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
	Estimated digestible nutrients in bread	....	106.3	....	1,393.3	....	6,533
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	89.8	96.3	97.8	58.9	(95.9)
	Estimated coefficients of digestibility of bread alone	....	79.8	....	97.8	....	(95.9)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	92.9
	In bread alone	....	....	....	....	....	94.0

During this experiment the subject eliminated 4,288 grams urine, containing 51.71 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 12.66 grams; outgo in urine 12.93 grams; and in feces 1.29 grams; implying a loss of 1.56 grams nitrogen, corresponding to 9.8 grams protein.

DIGESTION EXPERIMENT NO. 475.

Kind of food.—Milk, and bread made from Oregon Graham flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 174 pounds; at the close 174 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 30, 1903.

TABLE 11.—*Results of digestion experiment No. 475.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
311	Bread	3,431.0	209.6	38.4	1,807.5	52.8	8,790
312	Milk	8,194.0	145.0	357.3	436.7	65.6	5,581
	Total	....	354.6	395.7	2,244.2	118.4	14,371
325	Feces (water-free)	388.2	87.0	43.5	188.4	69.3	1,777
	Estimated feces from food other than bread	....	4.4	17.9	8.7	....	237
	Estimated feces from bread	....	82.6	....	179.7	....	1,540
	Total amount digested	....	267.6	352.2	2,055.8	49.1	12,594
	Estimated digestible nutrients in bread	....	127.0	....	1,627.8	....	7,250
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	75.5	89.0	91.6	41.5	(87.6)
	Estimated coefficients of digestibility of bread alone	....	60.6	....	90.1	....	(82.5)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	85.3
	In bread alone	....	....	....	....	....	80.7

During this experiment the subject eliminated 4,011 grams urine, containing 58.58 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 14.19 grams; outgo in urine 14.65 grams; and in feces 3.48 grams; implying a loss of 3.94 grams nitrogen, corresponding to 24.6 grams protein.

DIGESTION EXPERIMENT NO. 476.

Kind of food.—Milk, and bread made from Oregon Graham flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 154 pounds; at the close 156 pounds.

Duration.—Four days, with 12 meals, beginning with breakfast March 30, 1903.

TABLE 12.—*Results of digestion experiment No. 476.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
311	Bread	2,736.0	167.2	30.6	1,441.3	42.1	7,010
312	Milk	7,894.8	139.7	344.2	420.8	63.2	5,377
	Total		306.9	374.8	1,862.1	105.3	12,387
326	Feces (water-free)	288.5	62.2	30.2	139.8	56.3	1,239
	Estimated feces from food other than bread		4.2	17.2	8.4		220
	Estimated feces from bread		58.0		131.4		1,019
	Total amount digested		244.7	344.6	1,722.3	49.0	11,148
	Estimated digestible nutrients in bread		109.2		1,209.9		5,991
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		79.7	91.9	92.5	46.5	(90.0)
	Estimated coefficients of digestibility of bread alone		65.3		90.9		(85.5)
	Proportion of energy actually available to the body:						
	In total food						87.5
	In bread alone						83.5

During this experiment the subject eliminated 3,601 grams urine, containing 49.41 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 12.28 grams; outgo in urine 12.35 grams; and in feces 2.49 grams; implying a loss of 2.56 grams nitrogen, corresponding to 16 grams protein.

DIGESTION EXPERIMENT NO. 477.

Kind of food.—Milk, and bread made from Oregon Graham flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 154.5 pounds; at the close 151.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast March 30, 1903.

TABLE 13.—*Results of digestion experiment No. 477.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
311	Bread	1,563.0	95.5	17.5	823.4	24.1	4,004
312	Milk	6,398.4	113.2	279.0	341.0	51.2	4,358
	Total	....	208.7	296.5	1,164.4	75.3	8,362
327	Feces (water-free)	185.3	60.2	22.0	67.7	35.4	822
	Estimated feces from food other than bread	....	3.4	14.0	6.8	....	173
	Estimated feces from bread	....	56.8	....	60.9	....	649
	Total amount digested	....	148.5	274.5	1,096.7	39.9	7,540
	Estimated digestible nutrients in bread	....	38.7	....	762.5	....	3,355
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	71.1	92.6	94.2	53.0	(90.2)
	Estimated coefficients of digestibility of bread alone	....	40.5	....	92.6	....	(83.8)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	88.0
	In bread alone	....	....	....	....	....	82.6

During this experiment the subject eliminated 3,502 grams urine, containing 49.58 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 8.35 grams; outgo in urine 12.40 grams; and in feces 2.41 grams; implying a loss of 6.46 grams nitrogen, corresponding to 40.4 grams protein.

EXPERIMENTS WITH STRAIGHT-GRADE, ENTIRE-WHEAT, AND GRAHAM FLOURS (BREAD) FROM OKLAHOMA WHEAT.

The data of the experiments with bread made from the three grades of flour milled from the Oklahoma wheat are given in Tables 14 to 22, which follow.

DIGESTION EXPERIMENT NO. 478.

Kind of food.—Milk, and bread made from Oklahoma straight-grade flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 173 pounds; at the close 175 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 8, 1903.

TABLE 14.—*Results of digestion experiment No. 478.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
328	Bread	3,558.0	360.4	22.8	1,819.6	15.6	9,902
329	Milk	11,625.0	337.1	428.9	541.7	96.5	7,476
	Total	....	697.5	451.7	2,361.3	112.1	17,378

TABLE 14.—*Results of digestion experiment No. 478*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
342	Feces (water-free)	182.0	45.3	17.0	71.2	48.5	879
	Estimated feces from food other than bread		10.1	21.4	10.8		368
	Estimated feces from bread		35.2		60.4		511
	Total amount digested		652.2	434.7	2,290.1	63.6	16,499
	Estimated digestible nutrients in bread		325.2		1,759.2		9,391
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		93.5	96.3	97.0	56.7	(94.9)
	Estimated coefficients of digestibility of bread alone		90.2		96.7		(94.8)
	Proportion of energy actually available to the body:						
	In total food						90.3
	In bread alone						90.7

During this experiment the subject eliminated 7,171 grams urine containing 111.16 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 27.90 grams; outgo in urine 27.79 grams; and in feces 1.81 grams; implying a loss of 1.70 grams nitrogen, corresponding to 10.6 grams protein.

DIGESTION EXPERIMENT NO. 479.

Kind of food.—Milk, and bread made from Oklahoma straight-grade flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 156 pounds; at the close 162 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 8, 1903.

TABLE 15.—*Results of digestion experiment No. 479.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
328	Bread	2,673.0	270.8	17.1	1,367.0	11.7	7,439
329	Milk	7,513.0	217.9	277.2	350.1	62.4	4,829
	Total		488.7	294.3	1,717.1	74.1	12,268
343	Feces (water-free)	98.0	28.4	7.5	31.4	30.7	404
	Estimated feces from food other than bread		6.5	13.9	7.0		215
	Estimated feces from bread		21.9		24.4		189
	Total amount digested		460.3	286.8	1,685.7	43.4	11,864
	Estimated digestible nutrients in bread		248.9		1,342.6		7,250
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		94.2	97.4	98.2	58.6	(96.7)
	Estimated coefficients of digestibility of bread alone		91.9		98.2		(97.5)
	Proportion of energy actually available to the body:						
	In total food						[illegible].0
	In bread alone						[illegible].3

During this experiment the subject eliminated 4,995 grams urine, containing 79.77 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 19.55 grams; outgo in urine 19.94 grams; and in feces 1.14 grams; implying a loss of 1.53 grams nitrogen, corresponding to 9.6 grams protein.

DIGESTION EXPERIMENT NO. 480.

Kind of food.—Milk, and bread made from Oklahoma straight-grade flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 152 pounds; at the close 152 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 8, 1903.

TABLE 16.—*Results of digestion experiment No. 480.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
328	Bread	2,549.0	258.2	16.3	1,303.5	11.2	7,094
329	Milk	6,961.0	201.9	256.9	324.1	57.8	4,474
	Total	....	460.1	273.2	1,627.9	69.0	11,568
344	Feces (water-free)	104.0	30.3	14.4	31.0	28.3	443
	Estimated feces from food other than bread	....	6.0	12.8	6.5	....	182
	Estimated feces from bread	....	24.3	....	24.5	....	261
	Total amount digested	....	429.8	258.8	1,596.9	40.7	11,125
	Estimated digestible nutrients in bread	....	233.9	....	1,279.0	....	6,833
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	93.4	94.7	98.1	59.0	(96.2)
	Estimated coefficients of digestibility of bread alone	....	90.6	....	98.1	....	(96.3)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	91.5
	In bread alone	....	....	....	....	....	92.2

During this experiment the subject eliminated 4,558 grams urine, containing 63.56 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 18.40 grams; outgo in urine 15.89 grams; and in feces 1.21 grams; implying a gain of 1.30 grams nitrogen, corresponding to 8.1 grams protein.

DIGESTION EXPERIMENT NO. 481.

Kind of food.—Milk, and bread made from Oklahoma entire-wheat flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 174 pounds; at the close 173.75 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 15, 1903.

Table 17.—*Results of digestion experiment No. 481.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
345	Bread	3,597.0	381.3	37.4	1,658.6	33.8	9,762
346	Milk	11,569.0	332.0	497.5	532.1	81.0	8,203
	Total	....	713.3	534.9	2,190.7	114.8	17,965
359	Feces (water-free)	369.0	102.5	24.7	182.8	59.0	1,773
	Estimated feces from food other than bread	....	10.0	21.9	10.6	....	370
	Estimated feces from bread	....	92.5	....	172.2	....	1,403
	Total amount digested	....	610.8	510.2	2,007.9	55.8	16,192
	Estimated digestible nutrient in bread	....	288.8	....	1,186.4	....	8,359
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	85.6	95.4	91.7	48.6	(90.1)
	Estimated coefficients of digestibility of bread alone	....	75.7	....	89.6	....	(85.6)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	85.9
	In bread alone	....	....	....	....	....	81.9

During this experiment the subject eliminated 6,030 grams urine, containing 96.61 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 28.53 grams; outgo in urine 24.15 grams; and in feces 4.10 grams; implying a gain of 0.28 gram nitrogen, corresponding to 1.8 grams protein.

DIGESTION EXPERIMENT NO. 482.

Kind of food.—Milk, and bread made from Oklahoma entire-wheat flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 155.5 pounds; at the close 155 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 15, 1903.

Table 18.—*Results of digestion experiment No. 482.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
345	Bread	2,449.0	259.6	25.5	1,129.2	23.0	6,646
346	Milk	7,730.0	221.9	332.4	355.6	54.1	5,181
	Total	....	481.5	357.9	1,484.8	77.1	12,127
360	Feces (water-free)	193.5	47.2	14.1	97.3	34.6	860
	Estimated feces from food other than bread	....	6.7	16.6	7.1	....	235
	Estimated feces from bread	....	40.5	....	90.2	....	625
	Total amount digested	....	434.3	343.5	1,387.5	42.5	11,267
	Estimated digestible nutrients in bread	....	219.1	....	1,039.0	....	6,021

TABLE 18.—*Results of digestion experiment No. 482*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	90.2	96.0	93.4	55.1	(92.9)
	Estimated coefficients of digestibility of bread alone	....	84.4	....	92.0	....	(90.6)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	88.4
	In bread alone	....	....	....	....	....	86.5

During this experiment the subject eliminated 3,604 grams urine, containing 67.26 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 19.26 grams; outgo in urine 16.82 grams; and in feces 1.89 grams; implying a gain of 0.55 gram nitrogen, corresponding to 3.4 grams protein.

DIGESTION EXPERIMENT NO. 483.

Kind of food.—Milk, and bread made from Oklahoma entire-wheat flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 154.5 pounds; at the close 151.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 15, 1903.

TABLE 19.—*Results of digestion experiment No. 483.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
345	Bread	1,731.0	183.5	18.0	798.1	16.3	4,698
346	Milk	8,173.5	234.6	351.5	376.0	57.2	5,795
	Total	....	418.1	369.5	1,174.1	73.5	10,493
361	Feces (water-free)	193.5	46.2	20.1	87.4	39.8	873
	Estimated feces from food other than bread	....	7.0	17.6	7.5	....	247
	Estimated feces from bread	....	39.2	....	79.9	....	626
	Total amount digested	....	371.9	349.4	1,086.7	33.7	9,620
	Estimated digestible nutrients in bread	....	144.3	....	718.2	....	4,072
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	89.0	94.6	92.6	45.9	(91.7)
	Estimated coefficients of digestibility of bread alone	....	78.7	....	90.0	....	(86.7)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	87.3
	In bread alone	....	....	....	....	....	82.9

During this experiment the subject eliminated 6,266 grams urine, containing 60.17 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 16.72 grams; outgo in urine 15.04 grams; and in feces 1.85 grams; implying a loss of 0.17 gram nitrogen, corresponding to 1.1 grams protein.

DIGESTION EXPERIMENT NO. 484.

Kind of food.—Milk, and bread made from Oklahoma Graham flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 175 pounds; at the close 173.75 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 20, 1903.

TABLE 20.—*Results of digestion experiment No. 484.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
362	Bread	3,635.0	387.1	40.7	1,620.5	52.7	9,145
363	Milk	12,281.0	361.1	719.7	423.7	106.9	8,473
	Total	....	748.2	760.4	2,044.2	159.6	17,618
376	Feces (water-free)	486.0	111.0	49.2	242.7	83.1	2,297
	Estimated feces from food other than bread	....	10.8	36.0	8.5	....	470
	Estimated feces from bread	....	100.2	....	234.2	....	1,827
	Total amount digested	....	637.2	711.2	1,801.5	76.5	15,321
	Estimated digestible nutrients in bread	....	286.9	....	1,386.3	....	7,318
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	85.2	93.5	88.1	47.9	(87.0)
	Estimated coefficients of digestibility of bread alone	....	74.1	....	85.6	....	(80.0)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	82.4
	In bread alone	....	....	....	....	....	76.1

During this experiment the subject eliminated 7,383 grams urine, containing 107.46 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 29.93 grams; outgo in urine 26.87 grams; and in feces 4.44 grams; implying a loss of 1.38 grams nitrogen, corresponding to 8.6 grams protein.

DIGESTION EXPERIMENT NO. 485.

Kind of food.—Milk, and bread made from Oklahoma Graham flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 155 pounds; at the close 156 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 20, 1903.

TABLE 21.—*Results of digestion experiment No 485.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
362	Bread	2,672.0	284.6	29.9	1,191.2	38.7	6,723
363	Milk	7,234.3	212.7	423.9	249.5	63.0	4,991
	Total	....	497.3	453.8	1,440.7	101.7	11,714
377	Feces (water-free)	254.0	57.1	21.6	134.5	40.8	831
	Estimated feces from food other than bread	....	6.4	21.2	5.0	....	193
	Estimated feces from bread	....	50.7	....	129.5	....	641
	Total amount digested	....	440.2	432.2	1,306.2	60.9	10,880
	Estimated digestible nutrients in bread	....	233.9	....	1,061.7	....	6,082
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	88.5	95.2	90.7	59.9	(92.9)
	Estimated coefficients of digestibility of bread alone	....	82.2	....	89.1	....	(90.5)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	88.2
	In bread alone	....	....	....	....	....	86.1

During this experiment the subject eliminated 3.628 grams urine, containing 65.53 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 19.89 grams; outgo in urine 16.38 grams; and in feces 2.28 grams; implying a gain of 1.23 grams nitrogen, corresponding to 7.7 grams protein.

DIGESTION EXPERIMENT NO. 486.

Kind of food.—Milk, and bread made from Oklahoma Graham flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 153.5 pounds: at the close 152.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast April 20, 1903.

TABLE 22.—*Results of digestion experiment No. 486.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
362	Bread	1,661.0	176.9	18.6	740.5	24.1	4,179
363	Milk	7,089.8	208.4	415.5	244.6	61.7	4,891
	Total	....	385.3	434.1	985.1	85.8	9,070
378	Feces (water-free)	210.0	49.4	24.2	97.9	38.5	935
	Estimated feces from food other than bread	....	6.2	20.8	4.9	....	251
	Estimated feces from bread	....	43.2	....	93.0	....	684
	Total amount digested	....	335.9	409.9	887.2	47.3	8,135
	Estimated digestible nutrients in bread	....	133.7	....	617.5	....	3,495
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	87.2	94.4	90.1	55.1	(89.7)

TABLE 22.—*Results of digestion experiment No. 486*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Estimated coefficients of digestibility of bread alone	....	75.6	....	87.4	....	(83.6)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	85.1
	In bread alone	....	....	....	....	....	79.6

During this experiment the subject eliminated 4,920 grams urine, containing 57.99 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 15.41 grams; outgo in urine 14.50 grams; and in feces 1.98 grams, implying a loss of 1.07 grams nitrogen, corresponding to 6.7 grams protein.

SUMMARY OF RESULTS OBTAINED WITH BREAD FROM DIFFERENT GRADES OF FLOUR.

The results of the experiments showing the digestibility of the nutrients and availability of the energy of the three grades of flour are summarized in the following tables. Table 23 shows the percentages for the total food (bread and milk) and Table 24 the values computed for bread alone in the manner previously described (p. 18). These latter values are of particular interest.

TABLE 23.—*Digestibility of nutrients and availability of energy of total food.*

Experiment No.	Subject No.	Kind of food.	Protein.	Fat.	Carbohydrates.	Energy.
		Experiments with Oregon wheat.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
469	1	Milk and entire-wheat flour bread	89.8	93.7	94.9	87.8
470	2	.....do	90.4	94.8	95.2	89.0
471	3	.....do	87.2	91.9	94.6	87.4
		Average	89.1	93.5	94.9	88.1
472	1	Milk and straight-grade flour bread	93.1	96.6	98.0	92.8
473	2	.....do	93.9	97.2	98.7	94.1
474	3	.....do	89.8	96.3	97.8	92.9
		Average	92.3	96.7	98.2	93.3
475	1	Milk and Graham flour bread	75.5	89.0	91.6	85.3
476	2	.....do	79.7	91.9	92.5	87.5
477	3	.....do	[a] 71.1	92.6	94.2	88.0
		Average	77.6	91.2	92.8	86.9
		Experiments with Oklahoma wheat.				
481	1	Milk and entire-wheat flour bread	85.6	95.4	91.7	85.9
482	2	.....do	90.2	96.0	93.4	88.4
483	3	.....do	89.0	94.6	92.6	87.3
		Average	88.3	95.3	92.6	87.2
478	1	Milk and straight-grade flour bread	93.5	96.3	97.0	90.3
479	2	.....do	94.2	97.4	98.2	92.0
480	3	.....do	93.4	94.7	98.1	91.5
		Average	93.7	96.1	97.8	91.3
484	1	Milk and Graham flour bread	85.2	93.5	88.1	82.4
485	2	.....do	88.5	95.2	90.7	88.2
486	3	.....do	87.2	94.4	90.1	85.1
		Average	87.0	94.4	89.6	85.2

[a] Omitted from average.

TABLE 24.—*Digestibility of nutrients and availability of energy of bread alone.*

Experiment No.	Subject No.	Kind of food.	Protein.	Carbohydrates.	Energy.
		Experiments with Oregon wheat.	*Per cent.*	*Per cent.*	*Per cent.*
469	1	Entire-wheat flour bread	66.9	93.8	87.0
470	2	.....do	77.5	94.6	89.5
471	3	.....do	68.9	93.8	86.7
		Average	71.1	94.1	87.7
472	1	Straight-grade flour bread	85.6	98.0	94.8
473	2	.....do	89.4	98.9	96.3
474	3	.....do	79.8	97.8	94.0
		Average	84.9	98.2	95.0
475	1	Graham flour bread	60.6	90.1	80.7
476	2	.....do	65.3	90.9	83.5
477	3	.....do	[a]40.5	92.6	82.6
		Average	63.0	91.2	82.3
		Experiments with Oklahoma wheat.			
481	1	Entire-wheat flour bread	75.7	89.6	81.9
482	2	.....do	84.4	92.0	86.5
483	3	.....do	78.7	90.0	82.9
		Average	79.6	90.5	83.8
478	1	Straight-grade flour bread	90.2	96.7	90.7
479	2	.....do	91.9	98.2	93.3
480	3	.....do	90.6	98.1	92.2
		Average	90.9	97.7	92.1
484	1	Graham flour bread	74.1	85.6	76.1
485	2	.....do	82.2	89.1	86.1
486	3	.....do	75.6	87.4	79.6
		Average	77.3	87.4	80.6

[a] Omitted from average.

COMPARISON OF BREAD FROM THE THREE GRADES OF FLOUR FROM THE SAME LOT OF WHEAT.

In the experiments with Oregon wheat, the figures in Table 24 show striking differences in the digestion of protein of the same flour by the different subjects. Thus, subject No. 2 digested 65.3 per cent of the protein of Graham bread, whereas subject No. 3 digested only 40.5 per cent. The latter figure is considered abnormally low and is not included in the average. In the experiments with the entire-wheat bread, subject No. 1 digested 66.9 per cent of the protein, and subject No. 2 digested 77.5 per cent; and the variation was nearly as wide in the experiments with bread from straight-grade flour, ranging from 79.8 per cent with subject No. 3 to 89.4 per cent with subject No. 2. On the other hand, in the case of the carbohydrates and energy, the variations for the different subjects with the same flour were comparatively small. Notwithstanding the wide range in the digestibility of protein of the same flour by the different subjects, the results are in perfect accord in this respect, that each subject digested the nutrients of the straight-grade flour more thoroughly than those of the entire-wheat, and the nutrients of the latter more thoroughly than those of the Graham flour. Likewise the energy of the straight-grade flour was more available than that of entire-wheat or Graham.

In the experiments with Oklahoma wheat, there were also appreciable differences in the digestibility of the protein of the entire-wheat flour by the different subjects, and the same in the case of the Graham flour. The results for the protein of the straight-grade flour were in close agreement. As was the case with the Oregon flours, the results with the different subjects on the same flour agreed quite closely in respect to the digestibility of carbohydrates and the availability of energy. Furthermore, with each subject the digestibility of the nutrients and the availability of the energy of the different flours was in the following order: Straight-grade, entire-wheat, and Graham.

In brief, then, the flours from both kinds of wheat give the same results, namely, the nutrients of the straight-grade flour are more digestible than those of the entire-wheat flour, and the latter are more digestible than those of the Graham flour.

This means that, when the three flours compared are ground from the same lot of wheat, in actual nutritive value the straight-grade flour stands first, entire-wheat flour next, and Graham flour last. This may be more clearly apparent when the data are summarized in the manner shown in the following table:

Table 25.—*Proportion of total and digestible nutrients and total and available energy in different grades of Oregon and Oklahoma flour as milled.*

Sample No.	Kind of flour.	Protein (N×6.25).		Carbohydrates.		Energy per gram.	
		Total.	Digestible.	Total.	Digestible.	Total.	Available.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*	*Calories.*
271	Oregon Graham flour	8.97	5.65	79.48	72.49	3.990	3.284
272	Oregon entire-wheat flour	8.25	5.87	80.35	75.61	3.900	3.420
273	Oregon straight-grade flour	7.55	6.11	81.82	80.35	3.880	3.686
274	Oklahoma Graham flour	16.81	12.99	72.35	63.23	4.178	3.367
275	Oklahoma entire-wheat flour	16.63	13.24	73.05	66.11	4.159	3.485
276	Oklahoma straight-grade flour	15.06	13.69	73.57	71.88	4.040	3.721

In the case of the Oregon wheat, considering total protein, the Graham flour contained 8.97 per cent, the entire-wheat 8.25 per cent, and the straight-grade 7.55 per cent; but, considering digestible protein, the straight-grade flour contained 6.41 per cent, whereas the Graham flour contained only 5.65 per cent. Likewise the total energy per gram was 3.990 calories for Graham flour and 3.880 calories for straight-grade; but the available energy per gram was 3.686 calories for the straight-grade flour and only 3.284 calories for the Graham flour. In the case of the Oklahoma wheat also the proportions of total protein and energy were largest in the Graham and smallest in the straight-grade flour, whereas the proportions of digestible protein and available energy were largest in the straight-grade and smallest in the

Graham flour. That is, in the flours from both kinds of wheat the relative nutritive values of the three grades, as shown by digestible protein and available energy, were, first, straight-grade and, last, Graham.

In this respect the results obtained in these experiments are exactly in accord with those obtained in similar investigations with wheat from other localities. This means that from the same quantity of the three grades of flour from the same lot of wheat the body would actually obtain more protein and energy from the entire-wheat flour than from the Graham, and still more from the straight-grade flour than from the entire-wheat flour.

In general it may be said that the results obtained with the two sorts of wheat studied in the investigation here reported are in accord with those obtained in the earlier investigations of the series. This fact is a confirmation of the belief that the conclusions drawn regarding the nutritive value of different sorts of flour hold good for all varieties of wheat, provided the different flours are ground from the same sample.

COMPARISON OF BREAD FROM THE SAME GRADE OF FLOUR FROM THE TWO LOTS OF WHEAT.

Certain differences are noticeable in the digestibility of the nutrients and availability of the energy of the breads from similar grades of flour produced from the two lots of wheat. It will be observed that the percentage of digestible carbohydrates and available energy is larger, on the average, for each grade of flour from the Oregon wheat than for the same grade from the Oklahoma wheat, though the differences are not great. With the protein, on the other hand, the differences are larger and the conditions are reversed, the digestibility of the flours from the Oklahoma wheat being greater than that of the corresponding flours from the Oregon wheat. As previously noted, the flour from the Oregon wheat was comparatively low in protein, whereas that from the Oklahoma wheat was high.

In a former investigation[a] an attempt was made to determine the effect upon digestibility of adding wheat starch to a flour relatively rich in protein, in order to reduce the proportion of protein. In those experiments the difference between the percentage of protein in the normal flour and that in the same flour modified by the addition of starch was not so large as the difference between the protein content of the Oklahoma and that of the Oregon flour used in the present experiments. In the former experiments the digestibility of protein was lower in the flour with the increased starch content (i. e., reduced protein content) than in the normal flour. Similarly, in the present experiments, the protein was less digestible in the flour with the lower protein content, the differences in the present instance being even more pronounced than those in the earlier experiments. In both cases, then, the indications are that the widening of the ratio of protein to starch in the flour lowers the digestibility of the protein.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 101, p. 54.

As mentioned before, the differences in digestibility of the carbohydrates of the same grade of flour from the two lots of wheat were small, being largest in the case of the entire-wheat and Graham flours. In the case of the straight-grade flours 98.2 per cent of the carbohydrates from the Oregon wheat and 97.7 per cent from the Oklahoma wheat were digested. Since the carbohydrates of wheat flour are composed largely of starch, it is evident that wheat starch is a highly digestible nutrient, and more thoroughly digested in the form of straight-grade than in the other flours. The average difference in the digestibility of the carbohydrates of the breads made from the Graham and straight-grade flours amounts to 8.7 per cent in favor of the straight-grade flour.

UNDIGESTED STARCH IN FECES.

In former reports it was pointed out that the large particles observed in the fecal matter from the Graham and entire-wheat flours contained unaltered wheat-starch granules, which had escaped complete digestion. In the present digestion experiments also, microscopic studies showed the presence of unaltered starch grains in the feces from the Graham and entire-wheat flours.

EXPERIMENTS WITH BREAD FROM "BRAN FLOUR."

As pointed out in the preceding experiments in the present bulletin and in similar experiments previously reported, the Graham flour which contains the whole of the wheat kernel, including the bran, and is more coarsely ground than entire-wheat or standard patent flours, is less digestible than either of these two grades. The cause of this difference has sometimes been attributed to the coarseness of the branny particles. In order to determine what influence bran in a fine state of division would have upon the completeness of digestion, three experiments were made with straight-grade flour to which very finely ground bran was added. For convenience this material has been designated "bran flour."

This bran flour was prepared from milling products of Oklahoma wheat, described on pages 12 and 13. A quantity of the bran (No. 413) was ground in a burr mill and then in a Maerker mill until it was very fine. Some of the ground bran was then mixed with straight-grade flour (No. 276), the quantity of bran in the mixture (No. 415) being 14 per cent of the total, which was about the proportion of bran removed in milling. Bread was made from this modified flour in the same way as from the ordinary flours (see p. 18), and was used in digestion experiments with the same subjects as in the preceding experiments. One experiment was made with each subject. The data of the experiments are given in Tables 26 to 28, which follow.

DIGESTION EXPERIMENT NO. 487.

Kind of food.—Milk, and bread made from bran flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 182 pounds; at the close 179.5 pounds.

Duration.—Three days, with nine meals, beginning with breakfast May 23, 1903.

TABLE 26.—*Results of digestion experiment No. 487.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
379	Bread	2,043.0	194.1	17.2	930.6	18.6	5,105
380	Milk	8,854.6	309.0	436.5	318.8	91.2	7,084
	Total	....	503.1	453.7	1,249.4	109.8	12,189
393	Feces (water-free)	175.0	41.8	23.4	71.8	38.0	795
	Estimated feces from food other than bread	....	9.3	21.8	6.3	....	296
	Estimated feces from bread	....	32.5	....	65.5	....	499
	Total amount digested	....	461.3	430.3	1,177.6	71.8	11,394
	Estimated digestible nutrients in bread	....	161.6	....	865.1	....	4,606
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	91.7	94.9	94.3	65.4	(93.5)
	Estimated coefficients of digestibility of bread alone	....	83.2	....	93.0	....	(90.2)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	88.8
	In bread alone	....	....	....	....	....	86.3

During this experiment the subject eliminated 4,473 grams urine, containing 65.75 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 26.83 grams; outgo in urine 21.92 grams; and in feces 2.23 grams; implying a gain of 2.68 grams nitrogen, corresponding to 16.8 grams protein.

DIGESTION EXPERIMENT NO. 488.

Kind of food.—Milk, and bread made from bran flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 155 pounds; at the close 155.5 pounds.

Duration.—Three days, with nine meals, beginning with breakfast May 23, 1903.

TABLE 27.—*Results of digestion experiment No. 488.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
379	Bread	1,611.0	153.0	13.5	733.8	11.6	4,026
380	Milk	5,220.0	182.2	257.4	187.9	53.8	4,176
	Total	....	335.2	270.9	921.7	68.4	8,202
394	Feces (water-free)	129.5	29.3	12.9	56.6	30.7	544
	Estimated feces from food other than bread	....	5.5	12.9	3.7	....	172
	Estimated feces from bread	....	23.8	....	52.9	....	372
	Total amount digested	....	305.9	258.0	865.1	37.7	7,658
	Estimated digestible nutrients in bread	....	129.2	....	680.9	....	3,654
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	91.3	95.2	93.9	55.2	(93.4)
	Estimated coefficients of digestibility of bread alone	....	84.4	....	92.8	....	(90.8)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	88.7
	In bread alone	....	....	....	....	....	86.8

During this experiment the subject eliminated 3,016 grams urine, containing 62.73 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 17.88 grams; outgo in urine 20.91 grams; and in feces 1.56 grams; implying a loss of 4.59 grams nitrogen, corresponding to 28.7 grams protein.

DIGESTION EXPERIMENT NO. 489.

Kind of food.—Milk, and bread made from bran flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 158.5 pounds; at the close 156 pounds.

Duration.—Three days, with nine meals, beginning with breakfast May 23, 1903.

TABLE 28.—*Results of digestion experiment No. 489.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
379	Bread	1,558.0	148.0	13.1	709.7	14.2	3,893
380	Milk	5,660.0	197.5	279.0	203.8	58.3	4,528
	Total	....	345.5	292.1	913.5	72.5	8,421
395	Feces (water-free)	93.3	20.8	6.7	44.9	20.9	460
	Estimated feces from food other than bread	....	5.9	11.0	4.1	....	224
	Estimated feces from bread	....	14.9	....	40.8	....	236
	Total amount digested	....	321.7	285.4	868.6	51.6	7,961
	Estimated digestible nutrients in bread	....	133.1	....	668.9	....	3,657

Table 28.—*Results of digestion experiment No. 489*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		94.0	97.7	95.1	71.1	(94.5)
	Estimated coefficients of digestibility of bread alone		90.0		94.3		(93.9)
	Proportion of energy actually available to the body:						
	In total food						89.7
	In bread alone						89.7

During the experiment the subject eliminated 3,023 grams urine, containing 47.46 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 18.43 grams; outgo in urine 15.82 grams; and in feces 1.11 grams; implying a gain of 1.50 grams nitrogen, corresponding to 9.4 grams protein.

SUMMARY OF RESULTS OBTAINED WITH BREAD FROM BRAN FLOUR.

The results of the experiments with bread from bran flour are summarized in Table 29. For purposes of comparison the table also includes the average of experiments with bread made from the same flour without the bran.

Table 29.—*Digestibility of nutrients and availability of energy of bread from straight-grade flour with and without bran.*

Experiment No.	Subject No.	Kind of bread.	Protein.	Carbohydrates.	Energy.
			Per cent.	*Per cent.*	*Per cent.*
487	1	Bread from straight-grade flour with bran added	83.2	93.0	86.3
488	2	....do	84.4	92.8	86.8
489	3	....do	90.0	94.3	89.7
		Average	85.9	93.4	87.6
478	1	Bread from straight-grade flour without bran	90.2	96.7	90.7
479	2	....do	91.9	98.2	93.3
480	3	....do	90.6	98.1	92.2
		Average	90.9	97.7	92.1

In the experiments with the straight-grade flour without the bran the results with the three subjects were in very close agreement. In the experiments with the same flour plus bran the results for carbohydrates and energy agreed fairly well, but subject No. 3 digested more of the protein than either of the other subjects, the results for these two being close. Subject No. 3 digested practically the same proportion of the protein from the flour with the bran as from that without it, but with the other subjects the protein of the bran flour was noticeably less digestible than that of the straight-grade flour. With all three subjects the digestibility of the carbohydrates and the availability of the energy were lower for the bran flour than for the straight-grade flour.

Considering the averages of the experiments with both kinds of flour, the digestibility of the bread from the flour with the bran was, for protein 85.9 per cent and for carbohydrates 93.4 per cent, whereas that of the bread from the same flour without the bran was, for protein 90.9 per cent and for carbohydrates 97.7 per cent. The inference from these results is that the addition of the finely ground bran decreased the digestibility of the product.

Though the bran flour contained a larger percentage of protein than the flour without the bran, in consequence of its lower digestibility the nutritive value of the former was actually less, as will be apparent from a comparison of the data summarized in the following table, showing the percentages of total and digestible nutrients and the total and available energy per gram in both kinds of flour:

TABLE 30.—*Comparison of total and digestible nutrients and total and available energy in the same flour with and without bran.*

Sample No.	Kind of flour.	Protein (N × 6.25).		Carbohydrates.		Energy per gram.	
		Total.	Digestible.	Total.	Digestible.	Total.	Available.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*	*Calories.*
415	Straight grade flour with bran added .	15.35	13.19	72.23	67.46	3.876	3.395
276	Straight grade flour without bran	15.06	13.69	73.57	71.88	4.040	3.721

There was a larger percentage of total protein and a smaller percentage of total carbohydrates in the flour with the bran than in that without it; but comparing the digestible nutrients it will be observed that what little was gained in total amount added by including the finely ground bran was more than lost in the decreased digestibility due to the addition of the bran, the proportions of digestible nutrients and available energy being larger in the flour without the bran added. This means that from the same amounts of both kinds of flour the body would actually derive more nutrients and energy from the flour without the bran in spite of the fact that the amount of protein is larger in the flour with the bran added.

It is interesting to compare the average values for the digestibility of Graham and entire-wheat flours, that is, flours normally containing more or less coarse bran, with the average results obtained in digestion experiments with straight-grade patent flour to which finely ground bran was added. Such a comparison is made in the following table, which also shows the digestibility of straight-grade flour:

TABLE 31.—*Nutrients digested from bread from different kinds of flour.*

Kind of flour.	Protein.	Carbohydrates.
	Per cent.	*Per cent.*
Graham flour	77.3	87.4
Entire-wheat flour	79.6	90.5
Straight-grade flour with bran added	85.9	93.4
Straight-grade flour	90.9	97.7

As has been explained, the Graham flour contained the whole of the wheat kernel and was practically wheat meal, and the entire-wheat flour contained all of the kernel except the tough outer skin and was somewhat more finely ground than the Graham. The bran flour consisted of straight-grade flour that contained neither bran nor germ, to which was added the same amount of bran that had been removed in milling, the bran having been specially ground until it was about as fine as it seemed possible to make it. The entire-wheat flour was somewhat more digestible than the Graham, and the bran flour was more digestible than the entire-wheat, but less so than the straight-grade flour. It would seem from these data that the finer grinding of the bran increased its digestibility to a certain extent; but apparently its defective digestibility is not entirely due to imperfect grinding, because even when finely ground, flour containing it was still less digestible than the flour without the bran, which indicates that bran has some inherent property of resisting the digestive juices. That is to say, apparently, when bran was in a fine state of division, as in these experiments, it not only failed to digest completely itself, but it also prevented the complete digestion of the white flour with which it was associated.

The question has been studied by other investigators, and, in general, it may be said that in the majority of cases when the experimental conditions were uniform the results obtained are in accord with those reported here. No attempt is made here to refer to all of this work, though the reports of all such experiments which have been found are included in an unpublished bibliography of bread and related foods prepared in connection with the nutrition investigations of the Department of Agriculture and referred to in a previous publication.[a]

In a study of the comparative nutritive value of homemade and bakers' bread, Alice M. Fitz[b] found that a 10-cent loaf of bakers' whole-wheat bread was a little heavier, but contained a smaller percentage of protein and energy, than 10-cent loaves of three sorts of bakers' white bread. With bread prepared at home from uniform quantities and under uniform conditions less pronounced differences were noted in the composition and energy value of whole-wheat and ordinary breads.

Hutchison[c] gives results obtained by Goodfellow, showing "that the waste in milk is greater by 3 per cent when given along with whole-meal bread than when taken alone. This, as we have seen, is the very reverse of the effect exercised by ordinary bread."

Experiments by Romberg[d] have shown that a mixture of finely ground rye bran and flour is not so completely absorbed as the flour without the bran. A number of digestion experiments were made by him to determine the comparative digestibility of the different kinds and grades of rye flour. The experiments, which are of especial interest in connection with a discussion of the effect of the presence of bran in the flour on the digestibility of bread, are summarized in the table below. The data as originally published showed the percentage amounts which escaped digestion, but in quoting the results they have been recalculated to show the coefficients of digestibility, so that they may be more readily compared with those reported in this bulletin.

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[a] U. S. Dept. Agr., Rpt. Director Office Experiment Stations 1902, p. 267.

[b] Amer. Kitchen Mag., 17 (1902), p. 139.

[c] Food and the Principles of Dietetics. London: Edward Arnold, 1901, p. 206.

[d] Arch. Hyg., 28 (1897), p. 244.

TABLE 32.—*Coefficients of digestibility of different kinds of rye bread.*

Kind of flour used for making bread.	Dry matter.	Protein.	Carbohydrates.
	Per cent.	*Per cent.*	*Per cent.*
Fine light-colored rye flour	95.85	77.93	98.31
Fine rye flour containing a little bran	92.49	71.37	95.85
Fine dark-colored rye flour containing considerable bran	86.36	64.49	91.92
Rye graham flour mixed with a little fine flour	79.93	59.97	85.60
Rye flour ground from entire grain	94.22	67.98	97.59

From these tests and others made with the different rye milling products the conclusion was drawn that adding the bran, even if finely ground, diminished digestibility and that bran can not be so prepared by grinding that it is suited for human food.

Pannwitz,[a] in a study of the nutritive value of different sorts of army bread, also reported at length by Plagge and Lebbin,[b] took into account the effect of the presence of different proportions of bran on digestibility. In these experiments the diet consisted of bread alone. The following table summarizes the principal results and, as before, the data have been recalculated to show the coefficients of digestibility instead of the amounts which escaped digestion:

TABLE 33.—*Coefficients of digestibility of different sorts of bread.*

Kind of flour used for making bread.	Dry matter.	Protein
	Per cent.	*Per cent.*
Decorticated rye flour with 15 per cent bran removed	86.80	56.65
Coarse decorticated rye flour with 7.5 per cent bran removed	84.12	43.35
Coarse decorticated rye flour with 15 per cent bran removed	87.76	58.56
Finely ground decorticated rye flour with 10.84 per cent bran removed	87.76	66.38
Finely ground undecorticated rye flour with 12.68 per cent bran removed	87.39	60.88
Finely ground undecorticated rye flour with 25 per cent bran removed	90.51	66.25
Fine wheat flour with 30 per cent bran removed	93.93	81.31
Finely ground bran	57.65	43.68
Coarsely ground rye, no bran removed—"pumpernickel"	84.34	47.96
Entire-rye bread made from crushed grain without previous grinding	78.59	49.65

The conclusion was reached that the value of flour depended upon the amount of bran removed, and that bran, even if finely ground, was not suitable for human food. In the author's opinion, decortication before grinding is not necessary provided 15 to 25 per cent of the bran present is removed in milling; and, furthermore, unless 15 per cent of the bran is removed, the decorticated grain, either finely or coarsely ground, gives a bread of inferior digestibility.

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[a] Inaug. Diss., Univ. Berlin, 1898.

[b] Veröffentl. Mil. Sanitätsw., 1897, No. 12.

In a study of the relation of decortication and grinding to digestibility Lehmann[a] reports data which have to do with the effect of bran on the digestibility of bread. The data are summarized in Table 34.

TABLE 34.—*Coefficients of digestibility of different sorts of bread.*

Kind of flour used for making bread.	Dry matter.	Protein.
	Per cent.	*Per cent.*
Coarsely ground decorticated rye flour, Steinmetz process, 91 per cent of the grain.	85.73	45.30
Finely ground rye flour, old process, 70 per cent of the grain	89.25	44.25
Rather coarsely ground decorticated rye flour, Steinmetz process, 82 per cent of the grain	87.71	54.08
Finely ground rye flour, old process, 62 per cent of the grain	88.66	51.70
Finely ground commercial rye flour, 75 per cent of the grain	87.52	53.37

In the author's opinion the flour specially ground by the Steinmetz process, which contained not less than 15 per cent of bran, was about as digestible as ordinary rye-flour bread when it forms a part of a mixed diet, and, in general, he concludes that there was no marked and regular difference in the digestibility of flour from which 18 to 38 per cent of the bran was removed.

Lehmann's conclusions are not in accord with the others cited, and it seems fair to say that the consensus of opinion is unfavorable to bran as a constituent of flour.

EXPERIMENTS WITH BREAD FROM "GERM FLOUR."

Experiments similar to those with bran were also made to determine the influence of the addition of germ to white flour. A sample of germ (No. 414, obtained in milling flour No. 276) containing 29.88 per cent of protein and 11.23 per cent fat was ground in the same manner as the bran. A mixture, designated as "germ flour," was then made, containing 93 per cent of Oklahoma straight-grade flour (No. 276) and 7 per cent of the finely ground germ, the germ being added in about the same proportion as is removed during the milling process. Bread was made from this mixture as previously described, and a digestion experiment with each of the three subjects of the preceding experiments was conducted in the usual manner. The data of these experiments are given in Tables 35 to 37 following.

DIGESTION EXPERIMENT NO. 490.

Kind of food.—Milk, and bread made from germ flour.

Subject.—Man No. 1. Conditions as in experiment No. 469.

Weight.—At the beginning of the experiment 180 pounds; at the close 178 pounds.

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[a] Arch. Hyg., 45 (1902), p. 177.

Duration.—Three days, with nine meals, beginning with breakfast May 28, 1903.

TABLE 35.—*Results of digestion experiment No. 490.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
396	Bread	2,395.0	265.1	27.1	1,176.4	16.3	6,689
397	Milk	8,895.0	271.3	386.9	446.5	66.7	6,671
	Total		536.4	414.0	1,622.9	83.0	13,360
410	Feces (water-free)	135.3	41.0	14.6	43.9	35.8	659
	Estimated feces from food other than bread		8.2	19.4	8.9		312
	Estimated feces from bread		32.8		35.0		347
	Total amount digested		495.4	399.4	1,579.0	47.2	12,701
	Estimated digestible nutrients in bread		232.3		1,141.4		6,342
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		92.4	96.5	97.3	56.9	(95.1)
	Estimated coefficients of digestibility of bread alone		87.6		97.0		(94.8)
	Proportion of energy actually available to the body:						
	In total food						90.4
	In bread alone						90.5

During this experiment the subject eliminated 4,913 grams urine, containing 79.59 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 28.61 grams; outgo in urine 26.53 grams; and in feces 2.18 grams; implying a loss of 0.10 gram nitrogen, corresponding to 0.6 gram protein.

DIGESTION EXPERIMENT NO. 491.

Kind of food.—Milk, and bread made from germ flour.

Subject.—Man No. 2. Conditions as in experiment No. 470.

Weight.—At the beginning of the experiment 155 pounds; at the close 154 pounds.

Duration.—Three days, with nine meals, beginning with breakfast May 28, 1903.

TABLE 36.—*Results of digestion experiment No. 491.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams*	*Grams.*	*Calories.*
396	Bread	2,139.0	236.8	24.2	1,050.7	14.6	5,974
397	Milk	6,550.0	199.8	284.9	328.8	49.1	4,913
	Total		436.6	309.1	1,379.5	63.7	10,887
411	Feces (water-free)	93.0	27.1	9.7	28.9	27.3	403
	Estimated feces from food other than bread		6.0	14.3	6.5		213
	Estimated feces from bread		21.1		22.4		190
	Total amount digested		409.5	299.4	1,350.6	36.4	10,484
	Estimated digestible nutrients in bread		215.7		1,028.3		5,784

TABLE 36.—*Results of digestion experiment No. 491*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	93.8	96.9	97.9	57.2	(96.3)
	Estimated coefficients of digestibility of bread alone	....	91.1	....	97.9	....	(96.8)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	91.6
	In bread alone	....	....	....	....	....	92.3

During this experiment the subject eliminated 2,598 grams urine, containing 47.02 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 23.28 grams; outgo in urine 15.67 grams; and in feces 1.45 grams; implying a gain of 6.16 grams nitrogen, corresponding to 38.5 grams protein.

DIGESTION EXPERIMENT NO. 492.

Kind of food.—Milk, and bread made from germ flour.

Subject.—Man No. 3. Conditions as in experiment No. 471.

Weight.—At the beginning of the experiment 152 pounds; at the close 152 pounds.

Duration.—Three days, with nine meals, beginning with breakfast May 28, 1903.

TABLE 37.—*Results of digestion experiment No. 492.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
396	Bread	1,750.0	193.7	19.8	859.6	11.9	4,888
397	Milk	5,600.0	170.8	243.6	281.1	42.0	4,200
	Total	....	364.5	263.4	1,140.7	53.9	9,088
412	Feces (water-free)	79.0	22.1	12.8	23.9	20.2	357
	Estimated feces from food other than bread	....	5.1	12.2	5.6	....	171
	Estimated feces from bread	....	17.0	....	18.3	....	186
	Total amount digested	....	342.1	250.6	1,116.8	33.7	8,731
	Estimated digestible nutrients in bread	....	176.7	....	841.3	....	4,702
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	94.0	95.1	97.9	62.5	(96.1)
	Estimated coefficients of digestibility of bread alone	....	91.3	....	97.9	....	(96.2)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	91.4
	In bread alone	....	....	....	....	....	91.7

During this experiment the subject eliminated 3,542 grams urine, containing 51.71 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 19.44 grams; outgo in urine 17.24 grams; and in feces 1.18 grams; implying a gain of 1.02 grams nitrogen, corresponding to 6.4 grams protein.

SUMMARY OF RESULTS OBTAINED WITH BREAD FROM GERM FLOUR.

The results of the experiments with bread made from the mixture of straight-grade flour and ground germ are summarized in the following table. For comparison the results of experiments with bread made from the same flour without the germ are also included.

Table 38.—*Digestibility of nutrients and availability of energy of bread from straight-grade flour with and without germ.*

Experiment No.	Subject No.	Kind of bread.	Protein.	Carbohydrates.	Energy.
			Per cent.	*Per cent.*	*Per cent.*
490	1	Bread from flour with germ added	87.6	97.0	90.5
491	2	.....do	91.1	97.9	92.3
492	3	.....do	91.3	97.9	91.7
		Average	90.0	97.6	91.5
478	1	Bread from flour without germ	90.2	96.7	90.7
479	2	.....do	91.9	98.2	93.3
480	3	.....do	90.6	98.1	92.2
		Average	90.9	97.7	92.1

Subjects Nos. 1 and 2 digested slightly less and subject No. 3 slightly more protein from the flour with the germ than from that without it, the average from the latter flour being practically 1 per cent higher. The average for carbohydrates was the same for both kinds of flour, and the availability of energy was a trifle higher in the flour without the germ, but on the whole the differences in results were so small as to be negligible. Apparently, then, the presence of the finely ground germ exerts no appreciable influence upon the digestibility of the flour.

The relative nutritive value of the flour with and without the germ is illustrated by the data here summarized.

Table 39.—*Comparison of total and digestible nutrients and total and available energy in the same flour with and without germ.*

Sample No.	Kind of flour.	Protein (N×6.25).		Carbohydrates.		Energy per gram.	
		Total.	Digestible.	Total.	Digestible.	Total.	Available.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*	*Calories.*
416	Straight-grade flour with germ added	16.30	14.67	71.63	69.91	3.962	3.625
276	Straight-grade flour without germ	15.06	13.69	73.57	71.88	4.040	3.721

As will be seen from the data in Table 1, the proportion of protein in the germ is much larger than that in any other milling product from the same wheat, being in the sample analyzed nearly twice as large as in the straight-grade flour. Accordingly, the mixture of germ and straight-grade flour containing only 7 per cent of the former had an appreciably larger percentage of total protein than the straight-grade flour alone, 16.30 as compared with 15.06 per cent. Since the digestibility of the protein in the mixture was nearly the same as that in the flour without the germ, the percentage of digestible protein was also larger in the former, being 14.67 as compared with 13.69 per cent. The proportions of total and digestible carbohydrates, on the other hand, were both larger in the straight-grade flour alone, and their excess was sufficient to make the total and available energy per gram also larger in the flour without the germ. On the whole, then, the total nutritive value of the flour containing the germ is no greater than that without it.

Under certain circumstances, for example, where bread forms a considerable part of the total diet, a flour with a large protein content and a smaller starch content might be advantageous, because the proportion of starch to protein in flour is so large that a deficiency of protein might be characteristic of such a diet. The addition of the finely ground germ would then be an advantage, because, as shown above, the germ is rich in protein, and appreciably increases the protein content of the mixture; and the digestibility of the mixture is practically equal to that of the flour without the germ.

The particular disadvantage in including the germ is the effect it has upon the quality of the flour. The ground germ is easily fermentable and becomes rancid, and when present the flour does not keep well. Furthermore, it has been shown that the proteids of wheat germ are decidedly different in character and composition from wheat gluten, and that the agglutinating properties of the germ are poor.[a] A loaf from flour containing the germ, though sweeter in taste, is somewhat smaller in size and less attractive in appearance than one from straight-grade flour without the germ. From a practical standpoint, however, this latter feature is of much less importance than the poor keeping quality of the flour.

THE COMPARATIVE PECUNIARY VALUE OF GRAHAM, ENTIRE-WHEAT, AND STRAIGHT-GRADE FLOUR.

While the composition, digestibility, and palatability of a food are important factors in determining its value, the cost or comparative pecuniary value also requires consideration. Graham and entire-wheat flours are usually sold at a higher price than white or ordinary bread flour. Since the white (straight-grade) flour contains somewhat more digestible nutrients than either Graham or entire-wheat flours, it will readily be seen that for a given sum of money white flour would furnish the largest amount of digestible nutrients and available energy. At the time of this investigation flour was selling in the principal markets of the Northwestern States at a cost not exceeding $4.50 per barrel, while entire-wheat and Graham flour sold in small packages at the rate of $6 to $8 per barrel. In some cases much higher prices are charged for entire-wheat flour and similar preparations, as noted in studies carried on at the Maine Experiment Station.[a]

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[a] Minnesota Station Bul. 63, p. 527.

In the following table the comparative amounts of digestible nutrients which, at the prices given above, can be procured for 10 cents in the three types of flour milled from the Oklahoma wheat are given:

TABLE 40.—*Comparative amounts of digestible nutrients obtained for 10 cents in different grades of flour.*

Kind of flour.	Price per pound.	Total quantity obtainable.	Protein obtainable.	Carbohydrates obtainable.
	Cents.	*Pounds.*	*Pounds.*	*Pounds.*
White flour	2.25	4.4	0.60	3.16
Entire-wheat flour	3.00	3.3	.44	2.18
Graham flour	3.00	3.3	.43	2.09

At the prices given 10 cents will purchase 4.4 pounds of white and only 3.3 pounds of entire-wheat or Graham flour. The 4.4 pounds of white flour contain 1.24 pounds more of available protein and carbohydrates than 3.3 pounds of Graham costing the same amount of money. The 4.4 pounds of white flour contain 1.14 pounds more digestible protein and carbohydrates than the 3.3 pounds of entire-wheat flour costing the same amount of money. From a pecuniary point of view it is evident that the white flour is much the cheaper.

INCOME AND OUTGO OF NITROGEN.

Table 41 summarizes data regarding the income of nitrogen in the food and the outgo in the feces and urine, as well as the gain or loss by the body in the digestion experiments with the different sorts of bread reported in the preceding pages. The figures in each case represent the average amounts per day.

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[a] Maine Station Rpt. 1899, pp. 92-106.

TABLE 41.—*Average daily income and outgo of nitrogen in digestion experiments Nos. 469–492.*

Experiment No.	Subject No.	Kind of food.	Nitrogen.			
			In food.	In urine.	In feces.	Gain (+) or loss (−).
		Oregon wheat.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
469	1	Entire-wheat flour bread with milk	17.87	15.74	1.81	+0.32
470	2	.....do	17.56	13.16	1.69	+2.71
471	3	.....do	11.81	11.95	1.52	−1.66
472	1	Straight-grade flour bread with milk	16.34	17.91	1.12	−2.69
473	2	.....do	16.10	12.27	.98	+2.85
474	3	.....do	12.66	12.93	1.29	−1.56
475	1	Graham flour bread with milk	14.19	14.65	3.48	−3.94
476	2	.....do	12.28	12.35	2.49	−2.56
477	3	.....do	8.35	12.40	2.41	−6.46
		Oklahoma wheat.				
478	1	Straight-grade flour bread with milk	27.90	27.79	1.81	−1.70
479	2	.....do	19.55	19.94	1.14	−1.53
480	3	.....do	18.40	15.89	1.21	+1.30
481	1	Entire-wheat flour bread with milk	28.53	24.15	1.10	+ .28
482	2	.....do	19.26	16.82	1.89	+ .55
483	3	.....do	16.72	15.04	1.85	− .17
484	1	Graham flour bread with milk	29.93	26.87	4.44	−1.38
485	2	.....do	19.89	16.38	2.28	+1.23
486	3	.....do	15.41	14.50	1.98	−1.07
		Bran flour.				
487	1	Bran flour bread with milk	26.83	21.92	2.23	+2.68
488	2	.....do	17.88	20.91	1.56	−4.59
489	3	.....do	18.43	15.82	1.11	+1.50
		Germ flour.				
490	1	Germ flour bread with milk	28.61	26.53	2.18	− .10
491	2	.....do	23.28	15.67	1.45	+6.16
492	3	.....do	19.44	17.24	1.18	+1.02

The amount of nitrogen taken per day varied within rather wide limits, and it is noticeable that subject No. 3, in each series of tests, received considerably less nitrogen than the other two subjects, owing to the fact that he ate smaller amounts of food.

In experiments of a few days' duration it is not absolutely certain that the nitrogen of the urine represents that of the diet, though it seems probable that such is the case, as is indicated by the fact that marked changes in the nitrogen consumed are quickly followed by corresponding changes in the amounts excreted in the urine. In 11 of the experiments there was a gain of nitrogen and in 13 a loss. However, too much importance should not be attributed to these gains and losses, as the experimental periods were short and it is probable that in all cases nitrogen equilibrium would have been reached with the amounts consumed if the period had been longer. It is noticeable that on an average the feces from the coarser breads contained a larger proportion of the nitrogen consumed than was the case with the bread from straight-grade flour, a fact which has been brought out in referring to the lower coefficients of digestibility of the breads from the coarser flours. In general, no differences in the gains or losses of nitrogen were observed which could be attributed to the consumption of breads from different grades of flour.

GENERAL SUMMARY OF RESULTS AND CONCLUSIONS OF EXPERIMENTS WITH BREAD.

In eighteen digestion experiments with men it was found that white (straight-grade) flour was more completely digested than either Graham or entire-wheat flour, and yielded a larger amount of digestible nutrients and available energy. While Graham and entire-wheat flours contain more total protein and fat and have a higher heat of combustion, they actually yield to the body, because of their lower digestibility, smaller percentages of digestible nutrients and available energy than the straight-grade flour.

The same general differences in digestibility of the three grades of flour have been noted in experiments with hard northwestern spring wheats grown in Minnesota and Dakota, hard winter wheat grown in Oklahoma, and soft winter wheats grown in Michigan, Indiana, and Oregon. In fifty-four digestion trials with both hard spring wheats and soft winter wheats in which six separate samples of wheat have been milled so as to produce the three types of flour—Graham, entire-wheat, and straight-grade—uniform results have been secured, and in all of the comparative trials the largest amounts of available nutrients and energy have been secured from the white flour.

In the three digestion trials in which finely pulverized bran was added to white flour in the same proportion as is removed in milling, it was found that the addition of the bran lowered the digestibility of the flour so that a smaller amount of digestible nutrients and available energy was obtained from the bran flour than from the white flour with which the bran was mixed. The flour containing finely pulverized bran was more digestible than the coarsely granulated Graham flour, but less digestible than the white flour. When bran was finely pulverized it failed to digest as completely as the white flour and, therefore, the addition of the bran lowered the food value of the flour.

In three digestion trials in which finely pulverized wheat germ was added to white flour in the same proportion as is removed in milling, it was found that the addition of the germ did not materially change the digestibility of the flour, and that the amount of total digestible nutrients and available energy in the germ flour and the white flour was about the same. There was no material gain in total digestible nutrients by the addition of the germ to the white flour. The germ flour produced a smaller sized, sweeter, but less porous loaf than the white flour. Because of its fermentable character wheat germ is excluded from white flour.

As to pecuniary value, a larger amount of available nutrients and energy can be procured at the usual prices for a given sum of money in the form of white, that is, straight-grade, flour than of any other flour. White flour contains the largest amount of available nutrients, and is not only the most digestible, but at present average market prices is also the cheapest kind of flour. It should not be inferred, however, that the use of entire-wheat and Graham flour is to be discouraged. All the flours are very nutritious and economical foods, and experience has shown that they are wholesome as well. The differences in the amounts of total nutrients furnished the body by the various grades of flour are comparatively slight, all grades being quite thoroughly digested.

In discussing the nutritive value of the breads made from the three kinds of flour, the quite noticeable effect of the breads upon the subjects is of interest. In the experiments reported all the subjects expressed a preference for the white bread. The Graham bread, when it furnished the bulk of the ration for four days, produced a little discomfort, suggesting a slight irritation of the digestive tract. The ration of white bread and milk was less bulky in character and gave better results as to satiety and particularly as to ease of digestion. It should be borne in mind, however, that the tendency of the coarser flours to increase the peristaltic action of the intestines is often of undoubted value, particularly to persons of sedentary habit, and that their use as a laxative is in many cases extremely beneficial.

The use of different grades of flour for bread making is a convenient means of increasing the variety of the diet. Because of varying requirements no general rule can be laid down in the matter, and the extent to which the various grades of flour should be used must be determined largely by the individual himself.

In this investigation the comparative digestibility of the phosphates and other mineral constituents was not determined, nor were the quantities consumed and the amounts and proportions excreted in the urine and feces studied. As yet entirely satisfactory methods have not been generally adopted for determining the digestibility of mineral constituents, and consequently there is a lack of definite knowledge concerning body requirements and the changes which are involved in the metabolism of the ash constituents of the diet. Considerable work along these lines is now being carried on by a number of investigators in France and elsewhere in Europe, and in the United States studies of the forms in which ash constituents, especially phosphorus, occur in food products, methods of estimating phosphorus, sulphur, and other ash constituents in food and excretory products, and various problems concerning the functions of these elements are being taken up in connection with the nutrition investigations of this Office and by experiment station workers and other investigators. It is believed that this work may be more appropriately summarized when the investigations now in progress have been continued for a longer time.

THE DIGESTIBILITY AND NUTRITIVE VALUE OF MACARONI.

INTRODUCTION.

Macaroni and similar foods, grouped together under the name of Italian pastes, are commonly said to be of Italian origin, but as pointed out in a recent journal[a] there is reason for believing that they were introduced into Sicily and Calabria by the early Greek settlers, and that the invention of these food products is to be ascribed to the Greeks. There are undoubtedly grounds for this statement, yet it should be remembered that similar food products have been known since early times in China and Japan, where they are still manufactured in large quantities.

Italian pastes are usually made from durum, or macaroni, wheat; that is, varieties which are of a glutinous character. The wheat is ground less finely than for ordinary flour-making purposes, the product being a coarse granular middlings known as semolina. In making macaroni this semolina is made into a stiff dough, kneaded and then pressed into tubes and dried. Though prepared for the table in a number of ways, the first treatment usually consists in parboiling the dried macaroni twenty to thirty minutes.

In connection with investigations carried on by the Bureau of Plant Industry of this Department regarding durum wheat, information is given regarding the process of manufacture of macaroni and related topics in a recent bulletin,[b] and also in earlier publications the character of such wheat, the relative value of different varieties, and other questions are considered. At the South Dakota Experiment Station[c] the value of durum wheat flour for making bread, cake, and similar foods has been studied, and tests on the milling of this wheat and the manufacture of macaroni have also been made.

The composition of macaroni and similar Italian pastes has often been determined by analysis, some of the work of this character having been carried on by experiment station investigators or those connected with the nutrition investigations of this Department. Rubner,[d] Jacoangeli and Bonanni,[e] Cappelletti,[f] and perhaps other investigators have studied the composition of macaroni and similar goods, but the amount of available information on this subject is not large.

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[a] Home Sci. Mag., 20 (1903–4), p. 271.

[b] U. S. Dept. Agr., Bureau of Plant Industry Bul. 70.

[c] South Dakota Station Buls. 77 and 82.

[d] Ztschr. Biol., 15 (1879), p. 115.

[e] Bol. Not. Agr., 19 (1897), II, p. 434.

[f] Ztschr. Untersuch. Nahr. u. Genussmtl., 1 (1898), p. 384.

In order to determine the nutritive value of macaroni made from American wheat, two series of experiments were undertaken which included the milling of the wheat, the preparation of the macaroni, and the determinations of its nutritive value when eaten by healthy young men who had a fair amount of muscular exercise. The wheat used in the series of experiments made in 1904 was grown at the North Dakota Experiment Station, and that used in the experiments made in 1905 was obtained at the North Dakota Substation, located at Edgeley. In both series the wheat was milled in the new experimental roller mill (Pl. IV) at the Minnesota Experiment Station and the semolina manufactured into macaroni by the Minnesota Macaroni Company, of St. Paul.

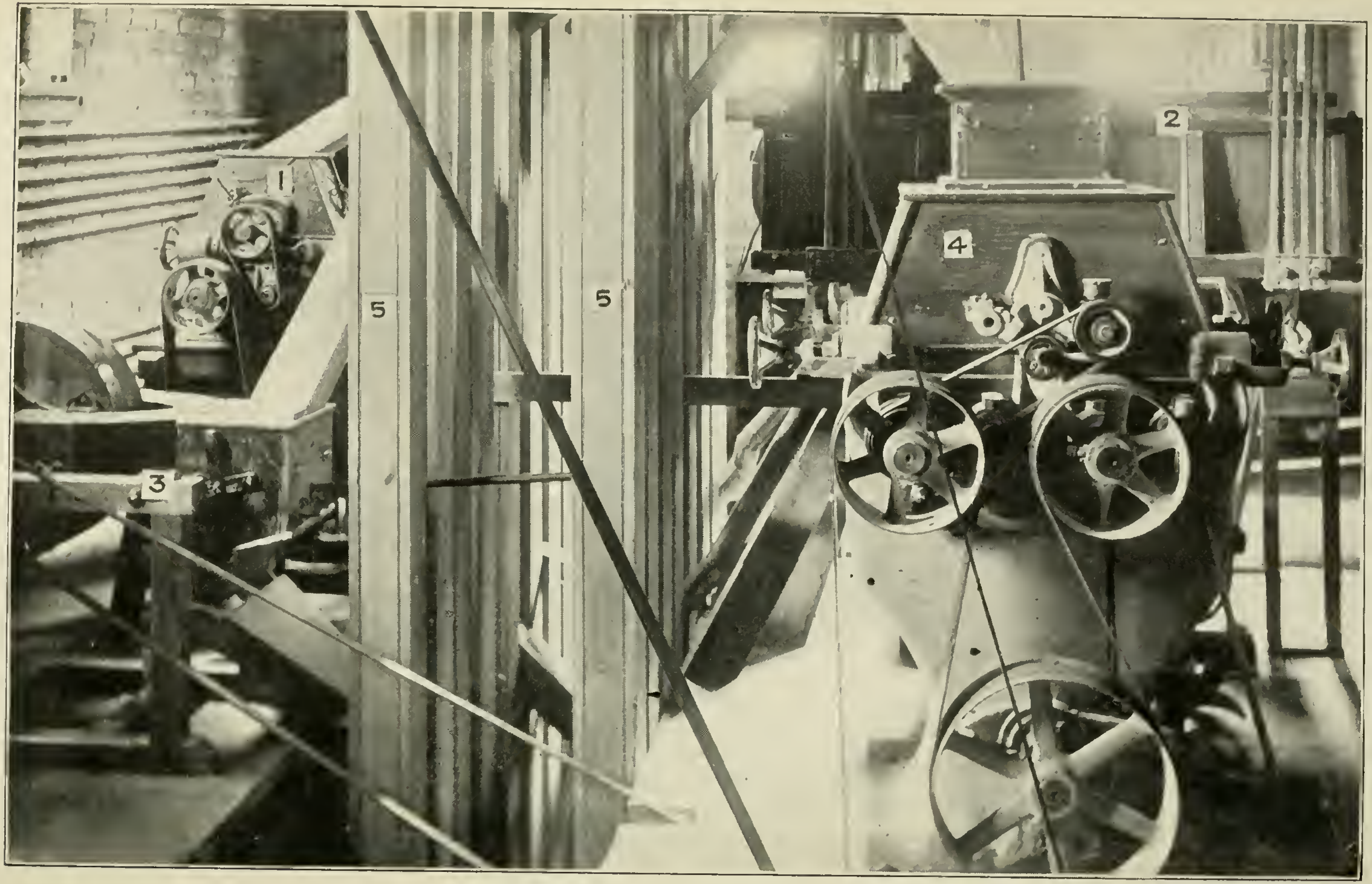
MILLING OF SAMPLES.

In the milling system employed the cleaned wheat is passed along to the first break, where it receives its first reduction. The "chop" is carried to the sifter by means of an elevator and separated into break flour, middlings, coarse bran, and material for the second break, where similar streams are obtained. The middlings are reduced between smooth rollers, purified by the aspirator, bolted in the sifter, and the reduced and purified product recovered as middlings flour or patent flour. In the system of milling followed, two grades of middlings flour, i. e., first and second, a break flour, and a low-grade flour, are obtained. From 70 to 75 per cent of the wheat milled, depending upon its quality, is recovered as flour with this experimental mill, and from 25 to 30 per cent is returned as bran, shorts, and feed.

The general plan of the milling system is shown in the figure herewith (fig. 1).

The milling plant used consists of two stands with corrugated and smooth rollers. By passing the material over the rolls a second time a four-break system of milling is secured. The milling of durum wheat for the production of semolina requires a different granulation and bolting of the middlings from that used in the preparation of flour from ordinary hard wheats for bread-making purposes. The aim is to secure medium coarse granular middlings, i. e., semolina, rather than fine flour, and it follows that the proportion of wheat obtained as middlings, which would ordinarily be reground, is greater than in flour milling. Manufacturers state that for macaroni making semolina is required which will not pass through a No. 10 bolting cloth. In milling for bread-making purposes the flour must be fine enough to pass through a No. 10 or 11, and in some cases a No. 12 or 14 bolting cloth.

For the investigations reported herewith the Kubanka variety of



EXPERIMENTAL FLOUR MILL.

1, second break (the first break is not shown); 2, sifter; 3, aspirator for purifying middlings; 4, middlings reduction rolls; 5, elevators for conveying mill streams.

durum wheat was selected as this appears to be one of the best varieties both as regards yield and the quality of its milling products. In each series of experiments the wheat selected was sound, bright, clean, and free from weed seeds, that used in 1904 weighing about 60 pounds to the bushel and that in 1905 about 63 pounds. As in ordinary milling, the wheat was softened or tempered by the addition of water prior to grinding. This prevents the bran from breaking up into fine pieces and contaminating the flour. Owing to the hard, flinty nature of the durum wheat a longer time and more water is required for tempering than with ordinary wheat flour. About a quart of water per 100 pounds of wheat was used, and the dampened grain was allowed to stand for twenty-four hours at a temperature of 20° C. before grinding.

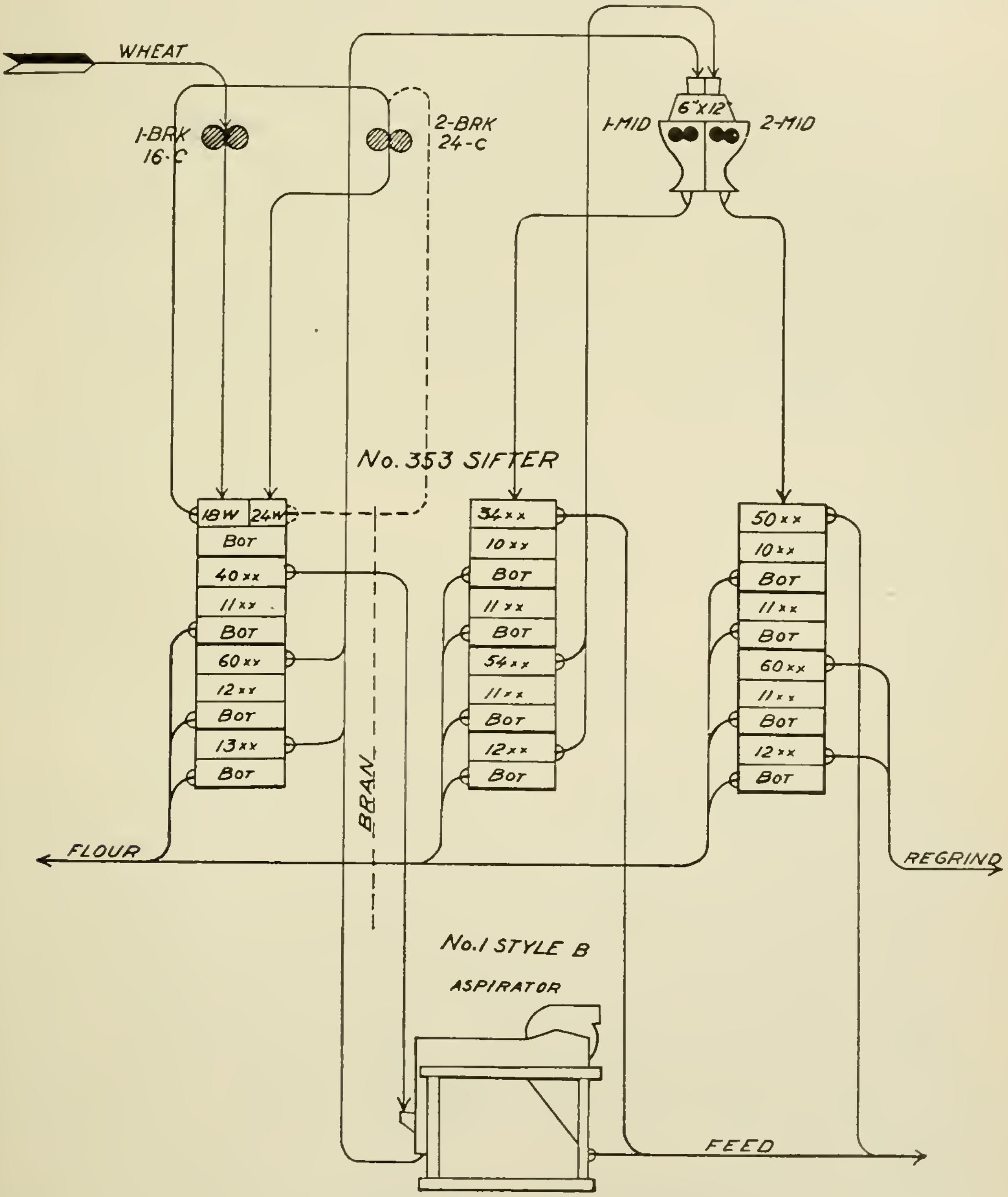

WHEAT
1-BRK
16-C
2-BRK
24-C
1-MID
6"X12"
2-MID
No. 353 SIFTER
18W
24W
BOT
40xx
11xx
BOT
60xx
12xx
BOT
13xx
BOT
34xx
10xx
BOT
11xx
BOT
54xx
11xx
BOT
12xx
BOT
50xx
10xx
BOT
11xx
BOT
60xx
11xx
BOT
12xx
BOT
FLOUR
BRAN
REGRIND
No. 1 STYLE B
ASPIRATOR
FEED

FIG. 1.—General plan of milling system.

The samples were milled under the supervision of Mr. Robert Dewar, an experienced miller, who at the time was engaged in special work in wheat and flour testing at the Minnesota School of Agriculture. The amount ground in 1904 weighed 250 pounds, and that in the following year 172 pounds. It was noted that the electric current used for running the mill registered 28 to 35 amperes instead of 25 to 32 amperes, as in milling ordinary hard Kansas and Dakota wheats. The following table shows the kinds and amounts of milling products obtained from the two lots of wheat ground:

Table 42.—*Milling products obtained from durum wheat.*

Kind of product.	Amount obtained.	
Experiments made in 1904.	*Pounds.*	*Per cent.*
First middlings flour	33	13.2
Second middlings flour	32	12.8
Coarse middlings flour	78	31.2
Break flour	10	4.0
Flour recovered from tailings	15	6.0
Flour recovered from feed	5	2.0
Bran	21	8.4
Shorts and fine bran	38	15.2
Feed	7	2.8
Aspirator bran and dust	3	1.2
Elevator boots, flour and stock in	5	2.0
Loss	3	1.2
Total	250	100.0
Experiments made in 1905.		
First middlings flour	31.8	18.4
Second middlings flour	38.5	22.4
Coarse middlings flour	16.5	9.6
Break flour	7.5	4.4
Tailings flour	12.5	7.3
Bran	29.0	16.8
Shorts	33.5	19.5
Loss (dust)	2.7	1.6
Total	172.0	100.0

In the first milling test 71.2 per cent of the wheat as milled was recovered as flour; 26.4 per cent as bran, shorts, and feed, and 1.2 per cent as aspirator dust. The total material recovered was a little less than the amount used, the loss in grinding being 1.2 per cent. In the second test 62.1 per cent of the wheat used was recovered as middlings and flour of different grades, and 36.3 per cent as offals. The loss in milling was 1.6 per cent. The higher flour yield in 1904 was largely due to regrinding the tailings and offals. This resulted in lowering the commercial grade of the flour, and hence was omitted in 1905.

As noted above, in milling durum wheat the bran breaks readily and forms fine particles which find their way into the shorts, and so it happens that the relative amounts of bran and shorts are about the opposite of those found in milling ordinary wheat. In milling ordinary varieties of hard wheat by this same milling system 70 to 75 per cent of the grain is obtained as flour, including all grades. It will be seen, therefore, that there is little difference in the total yield of flour from durum and ordinary varieties of hard wheat, when the offals from the durum wheat are remilled. A comparison of similar data for the two sorts shows the relative proportion of different grades of flour varies with the two types of wheat. Owing to the flinty character of the durum wheat there is a tendency for the stock to resist reduction and to find its way into the tailings. This results in an unequal division of the work of reduction among the various stands of rollers. When the coarse middlings and tailings are reground the final milling products obtained are about the same as with ordinary wheat.

COMPOSITION OF SAMPLES OF WHEAT AND MILLING PRODUCTS.

For purposes of comparison, samples of hard Scotch fife spring wheat, grown under the same conditions as the durum wheat, were milled.

The following table shows the composition of the durum wheats and the Scotch fife wheats selected for comparison, and their milling products, as well as of the macaroni made from the durum wheats:

TABLE 43.—*Composition of durum and hard spring wheats and their milling products.*

Sample No.	Kind of material.	Water.	Protein.	Fat.	Total carbohydrates.		Ash.
					Crude fiber.	Nitrogen-free extract.	
	Experiments made in 1904.						
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*
486	Durum wheat	8.76	12.37	2.07	74.92		1.88
	Durum wheat milling products:						
487	First middlings flour	10.85	11.69	1.47	75.20		.79
488	Second middlings flour	10.82	10.78	1.21	76.52		.67
489	Coarse middlings flour	10.72	11.75	1.52	75.29		.72
490	Break flour	11.32	12.36	2.10	72.92		1.30
495	Mixed flour (Nos. 487, 488, 489, 490)	10.77	11.64	1.27	75.56		.76
493	Shorts	11.62	14.05	3.42	68.59		2.32
494	Feed	10.00	12.37	3.22	72.47		1.94
491	Bran, coarse	11.86	12.82	4.21	65.86		5.25
492	Bran, fine	11.79	14.36	5.48	63.31		5.06
495A	Macaroni made from mixed flour No. 495	11.77	11.80	1.27	71.46		.70
496	Hard Scotch fife spring wheat	11.99	14.30	2.05	69.81		1.85
	Hard Scotch fife spring wheat milling products:						
497	First middlings flour	11.95	11.96	1.11	74.56		.42
498	Second middlings flour	10.84	11.89	1.28	75.54		.45
499	Break flour	11.51	13.54	1.42	73.00		.53
	Experiments made in 1905.						
600	Durum wheat	10.48	12.45	2.48	2.83	70.09	1.67
	Durum wheat milling products:						
601	First middlings flour	10.84	11.11	2.04	75.47		.54
602	Second middlings flour	9.91	11.95	2.24	75.36		.54
603	Coarse middlings flour	10.36	12.32	1.67	74.77		.88
604	Break flour	12.09	11.08	2.19	73.97		.67
605	Tailings flour	10.43	13.69	2.14	73.20		.54
606	Bran	11.77	13.28	5.39	9.09	56.67	3.85
607	Shorts and feed	11.10	12.99	7.93	8.64	56.79	2.55
582	Macaroni made from mixture of flours Nos. 601, 602, 603, 604	7.57	11.57	.89	79.06		.91
608	Hard Scotch fife spring wheat	11.91	12.09	2.16	2.58	69.19	2.07
	Hard Scotch fife spring wheat milling products:						
609	First middlings flour	11.15	10.60	1.11	76.66		.48
610	Second middlings flour	9.61	11.39	1.35	77.01		.64
611	Break flour	11.95	11.00	1.40	74.70		.95

As will be seen, the durum wheat used in 1904 contained 12.37 per cent of protein, while the hard Scotch fife wheat grown upon an adjoining field contained 14.30 per cent; the durum wheat used in 1905 contained 12.45 per cent and the hard Scotch fife wheat 12.09 per cent.

As is often the case, there is some difference in the appearance of the individual kernels of the durum wheat, and in connection with some work carried on at the Minnesota Experiment Station[a] the amount of protein in kernels of various character was studied. An average sample of the durum wheat milled in 1904 contained 12.37 per cent protein. Selected, dark-colored, hard, glutinous kernels showed 12.76 per cent, and light-colored, soft, starchy kernels, 10.60 per cent. Medium perfect kernels contained 12.56 per cent and small but equally well-filled ones 11.19 per cent. In former investigations[b] it has been shown that as a general rule the proportion of protein in standard patent flour is only 0.6 to 0.7 per cent less than in the wheat from which it was milled. In the case of the durum wheat the mixed flour or semolina contained 0.73 per cent less protein than the wheat, or approximately the same proportion as in the case of average hard wheat. As shown by the analyses reported, the durum wheat flour ground in 1904 and the flour and other milling products made from it contained about the same percentage amounts of protein, fat, and carbohydrates as are found in an average bread wheat and its milling products.

In durum wheat flour No. 495 it was found that 48.9 per cent of the total nitrogen present was in the form of gliadin. In patent flours made from hard spring wheat the gliadin nitrogen constitutes 52 to 61 per cent of the total nitrogen.[c] In the milling test carried on in 1905 it was observed that the durum wheat and also the ordinary wheat grown in the same locality contained less protein than the wheats ground the preceding year, and in fact a smaller proportion of this constituent than is usually the case with the local hard wheats. This is due, it is believed, to unusual climatic conditions, i. e., excessive rainfall and low temperature which prevailed during the growing season of the wheats. Notwithstanding its low protein content, the durum wheat selected is believed to be typical of similar wheats grown the same season in that part of Dakota. The flour samples milled from the durum wheat show in general the same percentage composition as those milled from the ordinary hard spring wheat selected for purposes of comparison.

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[a] Minnesota Station Bul. 85, p. 186.

[b] U. S. Dept. Agr., Office of Experiment Stations Bul. 101, p. 10.

[c] Minnesota Station Bul. 85, p. 207.

MANUFACTURE OF THE MACARONI.

In both tests the semolina used for the manufacture of macaroni included all the flour and middlings except the dark-colored break flour. The mixture was somewhat more finely ground and a little darker in color than that used for the commercial grades of macaroni, but it was the object to use as much of the wheat kernel as possible without including the break flour and offals rather than to prepare a high-grade commercial article which would include only a part of the middlings.

The macaroni was made in the presence of the author, the process of manufacture being as follows: The semolina was first mixed with about 30 per cent of water and made into a stiff dough by means of a mixing machine such as is used for bread-making purposes in many bakeries. The dough was then kneaded in a second machine provided with heavy iron rollers and passed to a third machine, where it was rolled into long thin sheets and finally made into rolls a foot or so in diameter and about 3 feet long. These rolls were placed in cylindrical presses provided with a perforated plate in the bottom with a wire suspended in each opening, though not so as to completely close the perforation. The dough is pressed through these orifices, making long, hollow tubes about one-eighth inch in diameter. The macaroni as it comes from the machine is spread by hand on trays, is cut into the desired lengths, and placed in racks to dry in the curing room at a temperature of 70° F. From seven to ten days are required for the drying and curing of the macaroni and it is then packed and ready for use.

The water used in mixing the dough is practically all removed in drying the macaroni, and, in this investigation, the analysis of the dry macaroni showed that it contained about the same percentage of moisture as the original flour or semolina. The conditions under which the drying takes place would suggest that but little loss of dry matter due to fermentation is possible. Indeed, mechanical losses appear to be the main losses in the preparation of macaroni, and these are not large. The conditions under which this macaroni was made did not permit of careful weighing of the flour and the finished product with a view to studying the losses and changes during manufacture. In fact, a study of its nutritive value was the object sought rather than a technical chemical study of the preparation of macaroni.

In the first test the composition of the mixed flour used for macaroni making was recorded. As will be seen by referring to Table 43, this flour (No. 495) and the uncooked macaroni made from it (No. 495A) have practically the same composition. A microscopic examination of the macaroni suggested that there was a slight change in the form and character of the starch granules due to the treatment received during the process of manufacture. The action of the water, the kneading, rolling, and drying influenced the physical character of the macaroni and possibly caused a slight hydration of the starch and proteids without materially affecting their percentage amounts.

COMPOSITION OF SAMPLES OF FOOD MATERIALS.

In connection with the digestion experiments samples of the food materials were analyzed in the usual way (see page 13). In the case of macaroni, samples of the raw material were analyzed. Composite samples of the bread were prepared for analysis in the way described on page 15. For each experimental period a composite sample of the milk or cream, which formed a part of the ration, was prepared by placing in a can each day quantities proportional to the total amounts consumed, potassium bichromate being used as a preservative. The following table shows the composition of the foods used in the digestion experiments:

Table 44.—*Composition of food materials used in digestion experiments with macaroni and durum wheat breakfast food.*

Sample No.	Kind of material.	Water.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
	Experiments made in 1904.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calorics.*
501	Macaroni, cooked, air-dry	12.01	11.64	1.27	74.37	0.71	3.860
500	Durum wheat flour bread	36.50	8.18	.89	53.46	.97	2.813
516	.....do	32.70	8.67	.94	56.67	1.02	2.982
502	Milk, composite sample	86.20	3.25	4.87	4.90	.78	826
509	.....do	86.48	3.44	4.68	4.65	.75	834
	Experiments made in 1905.						
582	Macaroni, raw	7.57	11.57	.89	79.06	.91	4.160
587	Durum wheat breakfast food	11.35	11.14	2.12	73.85	1.54	4.020
593	Milk	87.18	2.98	4.12	4.92	.80	770
583	Cream	79.44	3.37	10.65	5.72	.82	1.680

COMPOSITION OF FECES AND URINE.

The urine and feces were collected for analysis in the usual way, the separation of the feces pertaining to each experimental period being secured by the use of lampblack taken in capsules.[a] A composite sample of urine was prepared for analyses by uniting aliquot samples of the quantities voided each day. A small amount of formalin was used to prevent fermentation, and the samples were kept in a cool place. Tables 45 and 46 show the composition of the dry matter of the feces and the amount, specific gravity, and nitrogen content of the urine in the digestion experiments.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 143.

TABLE 45.—*Composition of dry matter of feces from digestion experiments with macaroni.*

Sample No.	Whence obtained.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Heat of combustion per gram.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Calories.*
503	Experiment No. 493	29.52	16.45	29.92	24.11	4.879
504	Experiment No. 494	24.10	14.86	37.40	23.64	5.302
505	Experiment No. 495	27.22	10.42	41.49	20.87	4.269
513	Experiment No. 496	28.07	12.24	29.69	30.00	4.197
514	Experiment No. 497	23.94	10.06	39.07	26.93	5.106
515	Experiment No. 498	32.59	10.07	29.91	27.43	4.240
597	Experiment No. 592	29.76	9.46	30.34	30.44	4.159
598	Experiment No. 593	23.75	8.62	39.07	28.56	4.776
599	Experiment No. 594	28.97	13.47	33.03	24.53	4.993
588	Experiment No. 595	20.15	8.01	51.09	20.75	4.774
589	Experiment No. 596	16.92	8.52	58.90	15.66	4.969
590	Experiment No. 597	21.91	11.06	51.14	15.89	4.920

TABLE 46.—*Amount, specific gravity, and nitrogen of urine from digestion experiments with macaroni.*

Sample No.	Subject No.	Whence obtained.	Total amount voided.	Specific gravity.	Nitrogen.
			Grams.		*Per cent.*
506	1	Experiment No. 493	5,506	1.027	1.28
507	2	Experiment No. 494	4,546	1.033	1.62
508	3	Experiment No. 495	5,230	1.025	1.13
510	1	Experiment No. 496	6,545	1.027	1.06
511	2	Experiment No. 497	6,655	1.031	1.20
512	3	Experiment No. 498	6,655	1.027	1.04
594	1	Experiment No. 592	1,619	1.024	1.04
595	2	Experiment No. 593	3,826	1.032	1.20
596	3	Experiment No. 594	4,722	1.029	1.25
584	1	Experiment No. 595	3,828	1.025	.86
585	2	Experiment No. 596	4,021	1.030	1.19
586	3	Experiment No. 597	5,482	1.022	.79

EXPERIMENTAL METHODS.

The general plan of these digestion experiments was the same as that for the comparison of the entire-wheat, graham, and straight-grade breads, described on page 18. All of the food consumed for a period of four days was weighed, sampled, and analyzed, as well as all the urine and feces pertaining to the experimental period.

In the calculation of the digestibility of the macaroni and durum wheat flour bread together, in the experiments made in 1904, and of the macaroni in those made in 1905, the milk which formed part of the ration was assumed to have the following digestibility: Protein, 97 per cent; fat, 95 per cent; carbohydrates, 98 per cent; energy available to the body, 95 per cent. These are the figures used in the digestion experiments with bread and milk already described in this bulletin.

The digestibility of the cereal alone in the experiments made with the breakfast food prepared from durum wheat was computed on the assumption that 97 per cent of the protein and 95 per cent of the fat of the cream eaten with it were digested.

DETAILS OF THE DIGESTION EXPERIMENTS.

In the first series of tests six experiments were made to determine the digestibility and nutritive value of the specially prepared macaroni. In order to give variety to the diet without using any considerable number of food materials, bread made from some of the flour used for the manufacture of the macaroni formed a part of the ration. This flour made bread of good quality, with a characteristic yellow tinge. The loaf was not quite as large or of so good quality as that made from a like amount of the hard wheat patent flours made from samples Nos. 497 and 498. The only food used in addition to cooked macaroni and bread made from durum wheat flour was milk. In the first three experiments about one-third more macaroni than bread (on the dry-matter basis) was used, while in the last three experiments the ration contained about two and a half times as much macaroni as bread. The subjects were healthy men engaged in moderately severe labor. In each case three subjects were used, and each experiment covered a period of four days.

The macaroni was prepared for the table by cooking in boiling water for twenty minutes, and a weighed quantity of the dried material was cooked separately for each subject. The water was drained off and a small amount of milk added. The macaroni was then warmed in an oven and served. Analyses were made of the waters drained from the cooked macaroni and it was found that they contained from 0.03 to 0.04 per cent of the total nitrogen originally present in the macaroni, as well as a somewhat larger amount of carbohydrates. In ordinary household practice the material removed would be lost, as the water in which the macaroni was cooked would be thrown away. The material lost constitutes about 2.25 per cent of the soluble material originally present in the macaroni, which is about the same quantity as is lost by the processes of fermentation followed in bread making.[a] It is natural to suppose that the quantity of water used would affect the amount of material dissolved from the macaroni, and it is obvious, therefore, that where strict economy is desired small rather than large amounts of water should be used. In calculating the results of the digestion experiments made in 1904 a correction was introduced for the proteids lost in cooking by deducting 0.03 per cent of nitrogen from the total amount present in the original material. With this correction it was found that the dry matter of the uncooked and the cooked macaroni had practically the same percentage composition. When compared on the basis of dry matter, little, if any, difference was observed between the composition of the durum flour, the cooked macaroni, and the durum-flour bread. In the experiments made in 1905, the quantities of nutrients supplied by the cooked macaroni were computed on the basis of the composition of the raw material, as the work of the previous year had shown that the composition of the air-dried, cooked, and raw macaroni was so similar that no appreciable error was introduced by this method.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 67, p. 33.

In the second series, three digestion experiments were made with a ration limited to macaroni and milk. The subjects, healthy young men engaged in moderate muscular work, were not inconvenienced by the simple character of the diet and it is believed that the results obtained may be regarded as normal.

For purposes of comparison three digestion experiments were also made with a breakfast cereal made from durum wheat. During the processes of manufacture of this rolled-wheat preparation a part of the bran was removed. This breakfast food, cooked in water in the usual way, was palatable and in flavor very much like similar breakfast foods prepared from ordinary wheat. It was eaten with cream, these two articles constituting the entire ration.

The details of the separate digestion experiments and the income and outgo of nitrogen are given in Tables 47 to 52.

EXPERIMENTS WITH MACARONI AND DURUM WHEAT BREAD.

DIGESTION EXPERIMENT NO. 493.

Kind of food.—Milk, macaroni, and bread made from durum flour.

Subject.—Man No. 1, 24 years of age, employed at farm labor.

Weight.—At the beginning of the experiment 173.5 pounds; at the close 173.25 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast June 11, 1904.

TABLE 47.—*Results of digestion experiment No. 493.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
501	Macaroni	900.0	104.8	11.4	669.3	6.4	3,474
500	Bread	965.0	78.9	8.6	515.9	9.3	2,715
502	Milk	7,050.0	229.1	343.4	345.5	55.0	5,823
	Total		412.8	363.4	1,530.7	70.7	12,012
503	Feces (water-free)	86.0	25.4	14.2	25.7	20.7	420
	Estimated feces from milk		6.9	17.2	6.9		247
	Estimated feces from macaroni and bread		18.5		18.8		173
	Total amount digested		387.4	349.2	1,505.0	50.0	11,592
	Estimated digestible nutrients in macaroni and bread		165.2		1,166.4		6,016
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		93.9	96.1	98.3	70.7	(96.5)
	Estimated coefficients of digestibilty of macaroni and bread		89.8		98.4		(97.2)
	Proportion of energy actually available to the body:						
	In total food						92.5
	In macaroni and bread						93.9

During this experiment the subject eliminated 5,506 grams urine, containing 70.48 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 16.51 grams; outgo in urine 17.62 grams; and in feces 1.02 grams; implying a loss of 2.13 grams nitrogen, corresponding to 13.3 grams protein.

DIGESTION EXPERIMENT NO. 494.

Kind of food.—Milk, macaroni, and bread made from durum flour.

Subject.—Man No. 2, 21 years of age, employed at farm labor.

Weight.—At the beginning of the experiment 178.5 pounds; at the close 179 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast June 11, 1904.

TABLE 48.—*Results of digestion experiment No. 494.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
501	Macaroni	1,300.0	151.3	16.5	966.8	9.3	5,018
500	Bread	1,280.0	104.7	11.4	684.3	12.4	3,601
502	Milk	8,615.0	280.0	419.6	422.1	67.2	7,116
	Total		536.0	447.5	2,073.2	88.9	15,735
504	Feces (water-free)	144.0	34.7	21.4	53.8	34.1	764
	Estimated feces from milk		8.4	21.0	8.4		337
	Estimated feces from macaroni and bread		26.3		45.4		427
	Total amount digested		501.3	426.1	2,019.4	54.8	14,971
	Estimated digestible nutrients in macaroni and bread		229.7		1,605.7		8,192
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food		93.5	95.2	97.4	61.7	(95.2)
	Estimated coefficients of digestibility of macaroni and bread		89.7		97.3		(95.0)
	Proportion of energy actually available to the body:						
	In total food						91.2
	In macaroni and bread						91.7

During this experiment the subject eliminated 4,546 grams urine, containing 73.65 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 21.44 grams; outgo in urine 18.41 grams; and in feces 1.39 grams; implying a gain of 1.64 grams nitrogen, corresponding to 10.3 grams protein.

DIGESTION EXPERIMENT NO. 495.

Kind of food.—Milk, macaroni, and bread made from durum flour.

Subject.—Man No. 3, 25 years of age, employed at janitor work.

Weight.—At the beginning of the experiment 140.5 pounds; at the close 140.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast June 11, 1904.

TABLE 49.—*Results of digestion experiment No. 495.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
501	Macaroni	1,250.0	145.5	15.9	929.6	8.9	4,825
500	Bread	1,283.0	104.9	11.4	685.9	12.5	3,609
502	Milk	6,325.0	205.6	308.0	309.9	49.3	5,224
	Total	....	456.0	335.3	1,925.4	70.7	13,658
505	Feces (water-free)	149.0	40.6	15.5	61.8	31.1	636
	Estimated feces from milk	....	6.2	15.4	6.2	....	203
	Estimated feces from macaroni and bread	....	34.4	....	55.6	....	433
	Total amount digested	....	415.4	319.8	1,863.6	39.6	13,022
	Estimated digestible nutrients in macaroni and bread	....	216.0	....	1,559.9	....	8,001
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	91.1	95.4	96.8	56.0	(95.3)
	Estimated coefficients of digestibility of macaroni and bread	....	86.3	....	96.6	....	(94.9)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	91.5
	In macaroni and bread	....	....	....	....	....	91.7

During this experiment the subject eliminated 5,230 grams urine, containing 59.10 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 18.24 grams; outgo in urine 14.78 grams; and in feces 1.62 grams; implying a gain of 1.84 grams nitrogen, corresponding to 11.5 grams protein.

DIGESTION EXPERIMENT NO. 496.

Kind of food.—Milk, macaroni, and bread made from durum flour.

Subject.—Man No. 1. Conditions as in experiment No. 493.

Weight.—At the beginning of the experiment 173.25 pounds; at the close 174 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast June 15, 1904.

TABLE 50.—*Results of digestion experiment No. 496.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
501	Macaroni	1,275.0	148.4	16.2	948.2	9.0	4,921
516	Bread	630.0	54.6	5.9	357.0	6.4	1,879
509	Milk	8,875.0	305.3	415.4	412.7	66.6	7,402
	Total	....	508.3	437.5	1,717.9	82.0	14,202
515	Feces (water-free)	123.0	34.5	15.1	36.5	36.9	516
	Estimated feces from milk	....	9.2	20.8	8.3	....	293
	Estimated feces from macaroni and bread	....	25.3	....	28.2	....	223
	Total amount digested	....	473.8	422.4	1,681.4	45.1	13,686
	Estimated digestible nutrients in macaroni and bread	....	177.7	....	1,277.0	....	6,577

TABLE 50.—*Results of digestion experiment No. 496*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	93.2	96.6	97.9	55.0	(96.4)
	Estimated coefficients of digestibility of macaroni and bread	....	87.5	....	97.8	....	(96.7)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	92.2
	In macaroni and bread	....	....	....	....	....	93.5

During this experiment the subject eliminated 6,545 grams urine, containing 69.38 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 20.33 grams; outgo in urine 17.35 grams; and in feces 1.38 grams; implying a gain of 1.60 grams nitrogen, corresponding to 10 grams protein.

DIGESTION EXPERIMENT NO. 497.

Kind of food.—Milk, macaroni, and bread made from durum flour.

Subject.—Man No. 2. Conditions as in experiment No. 494.

Weight.—At the beginning of the experiment 179 pounds; at the close 177.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast June 15, 1904.

TABLE 51.—*Results of digestion experiment No 497.*

Sample. No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
501	Macaroni	1,575.0	183.3	20.0	1,171.4	11.2	6,080
516	Bread	816.0	70.7	7.7	462.4	8.3	2,433
509	Milk	9,275.0	319.1	434.1	431.3	69.5	7,735
	Total	....	573.1	461.8	2,065.1	89.0	16,248
514	Feces (water-free)	132.0	31.6	13.3	51.6	35.5	674
	Estimated feces from milk	....	9.6	21.7	8.6	....	376
	Estimated feces from macaroni and bread	....	22.0	....	43.0	....	298
	Total amount digested	....	541.5	448.5	2,013.5	53.5	15,574
	Estimated digestible nutrients in macaroni and bread	....	232.0	....	1,590.8	....	8,215
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	94.5	97.1	97.5	60.1	(95.9)
	Estimated coefficients of digestibility of macaroni and bread	....	91.3	....	97.4	....	(96.5)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	91.7
	In macaroni and bread	....	....	....	....	....	93.1

During this experiment the subject eliminated 6,655 grams urine, containing 79.86 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 22.93 grams; outgo in urine 19.97 grams; and in feces 1.26 grams; implying a gain of 1.70 grams nitrogen, corresponding to 10.6 grams protein.

DIGESTION EXPERIMENT NO. 498.

Kind of food.—Milk, macaroni, and bread made from durum flour.

Subject.—Man No. 3. Conditions as in experiment No. 495.

Weight.—At the beginning of the experiment 140.5 pounds; at the close 138.5 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast June 15, 1904.

TABLE 52.—*Results of digestion experiment No. 498.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
501	Macaroni	1,305.0	151.9	16.6	970.5	9.3	5,037
516	Bread	657.0	57.0	6.2	372.3	6.7	1,959
509	Milk	6,225.0	214.1	291.3	289.5	46.7	5,192
	Total	....	423.0	314.1	1,632.3	62.7	12,188
515	Feces (water-free)	124.0	40.4	12.5	37.1	34.0	526
	Estimated feces from milk	....	6.4	14.6	5.8	....	204
	Estimated feces from macaroni and bread	....	34.0	....	31.3	....	322
	Total amount digested	....	382.6	301.6	1,595.2	28.7	11,662
	Estimated digestible nutrients in macaroni and bread	....	174.9	....	1,311.5	....	6,674
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	90.5	96.0	97.7	45.7	(95.7)
	Estimated coefficients of digestibility of macaroni and bread	....	83.7	....	97.7	....	(95.4)
	Proportion of energy actually available to the body:						
	In total food	....	....	....	....	....	91.8
	In macaroni and bread	....	....	....	....	....	92.3

During this experiment the subject eliminated 6,655 grams urine, containing 69.21 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 16.92 grams; outgo in urine 17.30 grams; and in feces 1.62 grams; implying a loss of 2 grams nitrogen, corresponding to 12.5 grams protein.

EXPERIMENTS WITH MACARONI.

DIGESTION EXPERIMENT NO. 592.

Kind of food.—Macaroni and milk.

Subject.—Man No. 1. College student 27 years old, engaged part of the time at light work.

Weight.—At the beginning of the experiment 150 pounds; at the close 150½ pounds.

Duration.—Four days, with twelve meals, beginning with breakfast February 21, 1905.

TABLE 53.—*Results of digestion experiment No. 592.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
593	Milk	4,070	121.29	167.68	200.24	32.56	3,133.9
582	Macaroni	1,225	141.73	10.90	968.49	11.15	5,096.0
	Total	5.295	263.02	178.58	1,168.73	43.71	8,229.9
597	Feces (water-free)	98	29.16	9.27	29.73	29.83	407.6
	Estimated feces from milk	....	3.64	8.38	4.00	....	123.5
	Estimated feces from macaroni	....	25.52	....	25.73	....	284.1
	Total amount digested	....	233.86	169.31	1,139.00	13.88	7,822.3
	Estimated digestible nutrients from macaroni	....	116.21	....	942.76	....	4,811.9
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	88.91	94.81	97.46	....	(95.05)
	Estimated coefficients of digestibility of macaroni	....	81.99	....	97.34	....	(94.42)
	Proportion of energy available to body:						
	In total food	....	....	....	....	....	91.49
	In macaroni alone	....	....	....	....	....	91.57

During this experiment the subject eliminated 1,619 grams urine, containing 16.84 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 10.58 grams; outgo in urine 4.21 grams; and in feces 1.17 grams; implying a gain of 5.20 grams nitrogen, corresponding to 32.50 grams protein.

DIGESTION EXPERIMENT NO. 593.

Kind of food.—Macaroni and milk.

Subject.—Man No. 2. Student 22 years old, engaged three hours per day at manual labor.

Weight.—At the beginning of the experiment 183 pounds; at the close 182 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast February 21, 1905.

TABLE 54.—*Results of digestion experiment No. 593.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
593	Milk	5,050	150.49	208.06	248.46	40.40	3,888.5
582	Macaroni	1,500	173.55	13.35	1,185.90	13.65	6,240.0
	Total	6,550	324.04	221.41	1,434.36	54.05	10,128.5
598	Feces (water-free)	100	23.75	8.62	39.07	28.56	477.6
	Estimated feces from milk	....	4.51	10.40	4.97	....	178.6
	Estimated feces from macaroni	....	19.24	....	34.10	....	299.0
	Total amount digested	....	300.29	212.79	1,395.29	....	9,650.9
	Estimated digestible nutrients from macaroni	....	154.31	....	1,151.80	....	5,941.0

TABLE 54.—*Results of digestion experiment No. 593*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	92.67	96.11	97.28	....	(95.28)
	Estimated coefficients of digestibility of macaroni	....	88.91	....	97.12	....	(95.21)
	Proportion of energy available to body:						
	In total food	....	....	....	....	....	91.28
	In macaroni alone	....	....	....	....	....	91.73

During this experiment the subject eliminated 3,826 grams urine, containing 45.91 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 12.96 grams; outgo in urine 11.48 grams; and in feces 0.95 gram; implying a daily gain of 0.53 gram nitrogen, corresponding to 3.31 grams protein.

DIGESTION EXPERIMENT NO. 594.

Kind of food.—Macaroni and milk.

Subject.—Man No. 3. College student 23 years old, with exercise equivalent to two hours per day of light work.

Weight.—At the beginning of the experiment 182 pounds; at the close 180 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast February 21, 1905.

TABLE 55.—*Results of digestion experiment No. 594.*

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
593	Milk	4,850	144.53	199.82	238.62	38.80	3,734.5
582	Macaroni	1,375	159.09	12.24	1,087.08	12.51	5,720.0
	Total	6,225	303.62	212.06	1,325.70	51.31	9,454.5
599	Feces (water-free)	114	33.02	15.35	37.65	27.96	569.2
	Estimated feces from milk	....	4.34	9.99	4.77	....	158.3
	Estimated feces from macaroni	....	28.68	5.36	32.88	....	410.9
	Total amount digested	....	270.60	196.71	1,288.05	23.35	8,885.3
	Estimated digestible nutrients from macaroni	....	130.41	6.88	1,054.20	....	5,309.1
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	89.12	92.76	97.16	....	(93.98)
	Estimated coefficients of digestibility of macaroni	....	81.97	56.21	96.97	....	(92.82)
	Proportion of energy available to body:						
	In total food	....	....	....	....	....	89.97
	In macaroni alone	....	....	....	....	....	89.34

During this experiment the subject eliminated 4,722 grams urine, containing 59.03 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 12.15 grams; outgo in urine 14.76 grams; and in feces 1.32 grams; implying a daily loss of 3.93 grams nitrogen, corresponding to 24.56 grams protein.

EXPERIMENTS WITH DURUM WHEAT BREAKFAST FOOD.

DIGESTION EXPERIMENT NO. 595.

Kind of food.—Durum wheat breakfast food and cream.

Subject.—Man No. 1. College student 27 years old, engaged part of the time at light work.

Weight.—At the beginning of the experiment 153 pounds; at the close 152 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast February 17, 1905.

TABLE 56.—*Results of digestion experiment No. 595.*

Sample No.		Weight of material.	Protien (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
583	Cream	1,720	57.96	183.18	98.38	14.10	2,889.6
587	Durum wheat breakfast food	1,075	119.76	22.79	793.89	16.56	4,321.5
	Total	2,795	177.72	205.97	892.27	30.66	7,211.1
588	Feces (water-free)	182	36.67	14.58	92.98	37.77	868.9
	Estimated feces from cream	....	1.74	9.16	1.97	....	121.6
	Estimated feces from durum wheat breakfast food	....	34.93	5.42	91.01	....	747.3
	Total amount digested	....	141.05	191.39	799.29	....	6,342.2
	Estimated digestible nutrients from durum wheat breakfast food	....	84.83	17.37	702.88	....	3,574.2
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	79.37	92.92	89.58	....	(87.95)
	Estimated coefficients of digestibility of durum wheat breakfast food	....	70.83	76.22	88.54	....	(82.77)
	Proportion of energy available to body:						
	In total food	....	....	....	....	....	85.56
	In durum wheat breakfast food alone	....	....	....	....	....	80.25

During this experiment the subject eliminated 3,828 grams urine, containing 32.92 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 7.11 grams; outgo in urine 8.23 grams; and in feces 1.47 grams; implying a daily loss of 2.59 grams nitrogen, corresponding to 16.19 grams protein.

DIGESTION EXPERIMENT NO. 596.

Kind of food.—Durum wheat breakfast food and cream.

Subject.—Man No. 2. Student 22 years old, engaged three hours per day at manual labor.

Weight.—At the beginning of the experiment 182 pounds; at the close 181 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast February 14, 1905.

TABLE 57.—*Results of digestion experiment No. 596.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
583	Cream	2,240	75.49	238.56	128.13	18.37	3,763.2
587	Durum wheat breakfast food	1,400	155.96	29.68	1,033.90	21.56	5,628.0
	Total	3,640	231.45	268.24	1,162.03	39.93	9,391.2
589	Feces (water-free)	234	39.59	19.94	137.83	36.64	1,162.7
	Estimated feces from cream	....	2.26	11.93	2.56	....	157.4
	Estimated feces from durum wheat breakfast food	....	37.33	8.01	135.27	....	1,005.3
	Total amount digested	....	191.86	248.30	1,024.20	....	8,228.5
	Estimated digestible nutrients from durum wheat breakfast food	....	118.63	21.67	898.63	....	4,622.7
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	82.89	92.56	88.14	....	(87.62)
	Estimated coëfficients of digestibility of durum wheat breakfast food	....	76.06	73.01	86.92	....	(82.14)
	Proportion of energy available to body:						
	In total food	....	....	....	....	....	85.07
	In durum wheat breakfast food alone	....	....	....	....	....	79.50

During this experiment the subject eliminated 4,021 grams urine, containing 47.85 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 9.26 grams; outgo in urine 11.96 grams; and in feces 1.58 grams; implying a daily loss of 4.28 grams nitrogen, corresponding to 26.75 grams protein.

DIGESTION EXPERIMENT NO. 597.

Kind of food.—Durum wheat breakfast food and cream.

Subject.—Man No. 3. College student 23 years old, with exercise equivalent to two hours per day of light work.

Weight.—At the beginning of the experiment 184 pounds; at close 182 pounds.

Duration.—Four days, with twelve meals, beginning with breakfast February 14, 1905.

TABLE 58.—*Results of digestion experiment No. 597.*

Sample No.		Weight of material.	Protein (N × 6.25).	Fat.	Carbohydrates.	Ash.	Energy.
	Food consumed:	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Calories.*
583	Cream	2,720	91.66	289.68	155.58	22.30	4,569.6
587	Durum wheat breakfast food	1,700	189.38	36.04	1,255.45	26.18	6,834.0
	Total	4.420	281.04	325.72	1,411.63	48.48	11,403.6
590	Feces (water-free)	253	55.43	27.98	129.38	40.20	1,244.8
	Estimated feces from cream	....	2.75	14.48	3.11	....	180.7
	Estimated feces from durum wheat breakfast food	....	52.68	13.50	126.27	....	1,064.1
	Total amount digested	....	225.61	297.74	1,281.65	....	10,158.8
	Estimated digestible nutrients from durum wheat breakfast food alone	....	136.70	22.54	1,129.18	....	5,769.9

TABLE 58.—*Results of digestion experiment No. 597*—Continued.

Sample No.		Weight of material.	Protein (N×6.25).	Fat.	Carbohydrates.	Ash.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
	Coefficients of digestibility of total food	....	80.28	91.41	90.83	....	(89.08)
	Estimated coefficients of digestibility of durum wheat breakfast food	....	72.18	62.54	89.94	....	(84.43)
	Proportion of energy available to body:						
	In total food	....	....	....	....	....	86.61
	In durum wheat breakfast food alone	....	....	....	....	....	81.93

During this experiment the subject eliminated 5,482 grams urine, containing 43.31 grams nitrogen. The average nitrogen balance per day was therefore as follows: Income in food 11.24 grams; outgo in urine 10.83 grams; and in feces 2.22 grams; implying a daily loss of 1.81 grams nitrogen, corresponding to 11.31 grams protein.

SUMMARY OF DIGESTION EXPERIMENTS WITH MACARONI AND DURUM WHEAT BREAKFAST FOOD.

The table below summarizes the results of the digestion experiments which were made with a ration of macaroni with durum wheat flour bread and milk, macaroni with milk, and durum wheat breakfast food with cream. For purposes of comparison the average results obtained in 21 experiments previously reported,[a] with a diet of patent wheat flour bread and milk, are also included.

TABLE 59.—*Digestibility of nutrients and availability of energy of entire rations containing macaroni and durum wheat flour products.*

Experiment No.	Subject No.	Kind of food.	Protein.	Fat.	Carbohydrates.	Energy.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
493	1	Macaroni and durum wheat flour bread 1:1 with milk	93.9	96.1	98.3	92.5
494	2	.....do	93.5	95.2	97.4	91.2
495	3	.....do	91.1	95.4	96.8	91.5
		Average of 3 experiments	92.8	95.6	97.5	91.7
496	1	Macaroni and durum wheat flour bread 2:1 with milk	93.2	96.6	97.9	92.2
497	2	.....do	94.5	97.1	97.5	91.7
498	3	.....do	90.5	96.0	97.7	91.8
		Average of 3 experiments	92.7	96.6	97.7	91.9
		Average of above 6 experiments	92.8	96.1	97.6	91.8
592	1	Macaroni with milk	88.9	....	97.5	91.5
593	2	.....do	92.7	....	97.3	91.3
594	3	.....do	89.1	....	97.2	90.0
		Average of 3 experiments	90.2	....	97.3	90.9
		Average of all above experiments	91.9	96.1	97.5	91.5
595	1	Durum wheat breakfast food with cream	79.4	....	89.6	85.1
596	2	.....do	82.9	....	88.1	84.5
597	3	.....do	80.3	....	90.8	86.6
		Average of 3 experiments	80.9	....	89.5	85.4
		Patent flour bread with milk, average of 21 experiments	93.3	95.6	98.1	92.3

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 85, 101, 126, 143.

From Table 59 it will be seen that on an average 92.8 per cent of the protein of a ration of macaroni, bread made from durum wheat flour, and milk was digested and 91.8 per cent of the energy was available. As will be seen by reference to the table practically the same results were obtained when the ration contained large and small proportions of the bread made from durum wheat flour. With a ration of macaroni and milk the results obtained were very similar, 90.2 per cent of the protein being digestible and 90.9 per cent of the energy available. Considering the average values for all the rations containing macaroni, 91.9 per cent of the protein was digestible and 91.5 per cent of the energy available. The results obtained with a ration of durum wheat breakfast food and cream were lower, 80.9 per cent of the protein being digestible and 85.4 per cent of the energy available.

Table 60 shows the calculated digestibility of the macaroni and durum wheat flour products alone, and for purposes of comparison the calculated digestibility of patent flour bread when forming part of a ration of bread and milk. The methods of calculating these results and the factors used have been explained on page 63.

Table 60.—*Digestibility of nutrients and availability of energy of macaroni and durum wheat flour products.*

Experiment No.	Subject No.	Kind of food.	Protein.	Carbohydrates.	Energy.
			Per cent.	*Per cent.*	*Per cent.*
493	1	Macaroni and durum wheat flour bread 1:1	89.8	98.4	93.9
494	2	.....do	89.7	97.3	91.7
495	3	.....do	86.3	96.6	91.7
		Average of 3 experiments	88.6	97.4	92.4
496	1	Macaroni and durum wheat flour bread 2:1	87.5	97.8	93.5
497	2	.....do	91.3	97.4	93.1
498	3	.....do	83.7	97.7	92.3
		Average of 3 experiments	87.5	97.6	93.0
		Average of above 6 experiments	88.1	97.5	92.7
592	1	Macaroni	82.0	97.3	91.6
593	2	.....do	88.9	97.1	91.7
594	3	.....do	82.0	97.0	89.3
		Average of 3 experiments	84.3	97.1	90.9
		Average of all above experiments	86.8	97.4	92.1
595	1	Durum wheat breakfast food	70.8	88.5	80.3
596	2	.....do	76.1	86.9	79.5
597	3	.....do	72.2	89.9	81.9
		Average of 3 experiments	73.0	88.4	80.6
		Patent flour bread, average of 21 experiments	88.1	97.8	92.0

On an average 88.1 per cent of the protein of macaroni and bread made from durum wheat flour was digested and 92.7 per cent of the energy was available. Considering the above average values and the range in the results of the individual tests, it will be seen that the presence of large or small proportions of bread made from durum wheat flour had little effect on the digestibility of the total cereal food in the ration. This would indicate that the bread made from durum wheat flour had practically the same digestibility as the macaroni—that is, that it made little difference as regards digestibility whether the flour was made into a paste which was dried, boiled, and eaten or into a dough which was baked. In the tests in which macaroni was eaten without bread on an average 84.3 per cent of the protein was digested and 90.9 per cent of the energy available. Considering both range and average values, the figures obtained for macaroni alone agree quite closely with those obtained for macaroni plus durum wheat flour bread. When all the rations containing macaroni are taken into account it is found that on an average 86.8 per cent of the protein was digestible and 92.1 per cent of the energy available. Somewhat lower results were obtained with the durum wheat breakfast food than with the macaroni made from the same lot of wheat, the coefficient of the digestibility of protein being 73.0 per cent and the coefficient of availability of energy 80.6 per cent.

As will be seen by Table 60 the results obtained with macaroni differ little from the average values obtained with bread made from straight-grade flour.

As to the cost of nutrients of bread and macaroni, prices differ in different localities and at different times to such an extent that only general comparisons are possible. A pound of dry macaroni retailing for 10 cents contains approximately the same amount of nutrients as are present in 1.3 to 1.4 pounds of bread costing from 6 to 10 cents, the difference in nutritive value per pound of the two materials being due largely to a difference in water content. In other words, macaroni furnishes, pound for pound, somewhat more nutritive material than bread but at a higher cost. The use of macaroni in the diet is a matter which depends quite largely upon food habits and the relative cost of materials. In Italy, as is well known, this food is much more commonly used than in the United States. The results of dietary studies made in Chicago[a] confirms the belief that after immigration to this country the Italians retain in large measure their food habits, and macaroni is still a very important article of diet, replacing bread and other common cereal foods to a considerable extent. Macaroni and similar Italian pastes are favorite articles of diet in many American families. The experimental and other evidence available confirms the opinion that the Italian pastes are digestible and nutritious articles of diet, but that at ordinary prices bread is a somewhat cheaper source of nutrients. The use of macaroni is, however, desirable because of the variety which it introduces into the menu and the possibility it affords of making satisfactory combinations with other food materials.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 55.

As regards the use of durum wheat for making breakfast foods, the experiments reported herewith show that it is possible to produce goods which in composition and digestibility compare favorably with whole-wheat flour. The superior digestibility of the macaroni and bread is probably due to the fact that the ground grain from which these products are made offers a better opportunity for the action of the digestive juices than the flaked kernels of the breakfast food.

THE RESULTS OF AMERICAN AND OTHER EXPERIMENTS WITH MACARONI.

As noted on another page (p. 55), Rubner, Jacoangeli and Bonanni, and Cappelletti have studied the digestibility of macaroni and similar products, and it is interesting to compare the results of their experiments with those obtained in the investigations carried on at the Minnesota Experiment Station.. The earliest of these experiments are those made by Rubner with a healthy man who lived exclusively on the materials studied. In the macaroni tests these were macaroni noodles made with and without the addition of wheat gluten. In one of the tests "Spaetzels," a sort of flour paste poured through a sieve into boiling water and quickly cooked, constituted the entire ration. When cooked this material seems comparable with macaroni or similar foods, though of course it is unlike them as regards method of preparation.

In connection with an investigation of the value of Indian corn, alone or with wheat, for making alimentary pastes, Jacoangeli and Bonanni studied the digestibility of macaroni made from wheat, as well as that of pastes from corn and corn and wheat, and also of corn-meal mush, such as is commonly eaten in Italy, i. e., polenta. The subject of the experiments was a healthy man. In the test with macaroni and other pastes these foods constituted the entire diet, being eaten in the form of soup. In all the tests two meals were taken each day, one at 10 o'clock in the morning and the other at 4 o'clock in the afternoon. So far as can be learned, the studies of the value of Indian corn for use in the manufacture of alimentary pastes, though undertaken upon a comparatively large scale, never passed the experimental stage.

Using three men as subjects, Cappelletti studied the digestibility of macaroni or a similar Italian paste, rice and "sitos," a sort of breakfast food made from a Sardinian variety of durum wheat by splitting the grain lengthwise and removing the outer layer. The foods were eaten in the form of thick soup.

The following table summarizes the results obtained by these investigators as well as the average results obtained at the Minnesota Experiment Station. In the case of the experiments cited for comparison, data regarding the coefficients of the availability of energy were not reported nor could these values be calculated from the experimental data included in the original publications.

Table 61.—*Summary of American and other experiments on the digestibility of macaroni.*

Kind of food.	Dry matter.	Protein.	Fat.	Carbohydrates.	Energy.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Macaroni noodles (Rubner)	95.7	82.9	94.3	99.8	....
Macaroni noodles with wheat gluten (Rubner)	94.3	88.8	93.0	97.7	....
Spaetzels (Rubner)	95.1	79.5	....	98.4	....
Macaroni made from best quality wheat flour (Jacoangeli and Bonanni)	96.1	91.2	87.6	97.5	....
Macaroni made from low-grade flour (Jacoangeli and Bonanni)	94.8	90.8	86.2	96.3	....
Macaroni (Cappelletti)	....	86.9	87.9	97.4	....
Durum wheat breakfast food (Cappelletti)	....	78.7	92.0	96.1	....
Macaroni with durum wheat flour bread (Snyder)	....	88.1	....	97.5	92.7
Macaroni (Snyder)	....	84.3	....	97.1	90.9
Durum wheat breakfast food (Snyder)	....	73.0	....	88.4	80.6

It will be seen from the figures in the above table that the results obtained with macaroni in the experiments at the Minnesota Experiment Station agree quite closely with those obtained by the European investigators quoted. In other words, the American-grown durum wheat produced macaroni which was equal in this respect to that made from European wheats. When it is remembered that the American macaroni is of excellent quality, and in appearance, flavor, and composition very like the standard European products, the conclusion seems warranted that in all important respects the American material is equal to the European. As previously noted, the breakfast food tested at the Minnesota Experiment Station had somewhat lower coefficients of digestibility than the macaroni made from the same lot of wheat, and it is interesting to note that Cappelletti also found that the durum wheat breakfast food contained somewhat lower proportions of digestible nutrients than the macaroni. The published data at present available regarding the average coefficients of breakfast foods from ordinary varieties of wheat are too limited for satisfactory comparisons, but it seems probable that durum wheat breakfast foods compare favorably with other wheats in this respect.

INCOME AND OUTGO OF NITROGEN.

In connection with the digestion experiments with macaroni and durum wheat breakfast food the income and outgo of nitrogen was determined. The data of this character for the individual experiments is summarized in Table 62:

TABLE 62.—*Average daily income and outgo of nitrogen in digestion experiments Nos. 493–498, 592–597.*

Experiment No.	Subject No.	Kind of food.	Nitrogen.			
			In food.	In urine.	In feces.	Gain (+) or loss (−).
			Grams.	*Grams.*	*Grams.*	*Grams.*
493	1	Macaroni and durum wheat flour bread 1:1 with milk	16.51	17.62	1.02	−2.13
494	2	.....do	21.41	18.41	1.39	+1.64
495	3	.....do	18.24	14.78	1.62	+1.84
496	1	Macaroni and durum wheat flour bread 2:1 with milk	20.33	17.35	1.38	+1.60
497	2	.....do	22.93	19.97	1.26	+1.70
498	3	.....do	16.92	17.30	1.62	−2.00
592	1	Macaroni with milk	42.33	16.84	4.67	+5.21
593	2	.....do	51.85	45.91	3.80	+ .54
594	3	.....do	48.58	59.03	5.28	−3.93
595	1	Durum wheat breakfast food with cream	28.43	32.92	5.87	−2.59
596	2	.....do	37.03	47.85	6.33	−4.29
597	3	.....do	44.95	43.31	8.88	−1.81

In six of the experiments there was an average daily gain of nitrogen and in an equal number there was a loss. As was noted in the discussion of data regarding the income and outgo of nitrogen in experiments with different sorts of bread reported earlier in this bulletin (p. 52), it is probable that in every case nitrogen equilibrium would have been reached if the experimental periods had been longer. On an average the proportion of nitrogen excreted in the feces was greater with the durum wheat breakfast food, i. e., with the coarser product, than with the macaroni, as might be inferred from the somewhat lower digestibility of the breakfast cereal referred to in the discussion of the digestion experiments. In general, no differences in the nitrogen balance were observed which could be attributed to the durum wheat products consumed.

CONCLUSIONS OF EXPERIMENTS WITH MACARONI.

In these investigations two samples of durum wheat grown in North Dakota were milled with an experimental mill at the Minnesota Experiment Station and the product obtained was made into macaroni, which was used for digestion experiments with healthy young men engaged in a fair amount of muscular work as subjects. It was found that when the offals from the durum wheat were remilled the total yield of flour from durum wheat was approximately the same as from ordinary wheats, but that the different grades of flour were obtained in somewhat different proportions. The durum wheat was somewhat harder to reduce and required more power in milling than ordinary wheat. The manufacture of semolina from durum wheat requires somewhat different tempering, granulation, and bolting than are required in the manufacture of flour for bread-making purposes from ordinary wheat. In the manufacture of macaroni the semolina or coarse flour undergoes both physical and chemical changes. Water is removed in drying the macaroni and the starch and gluten apparently undergo a slight hydration. When macaroni is cooked in water about 2.25 per cent of the soluble matters present are extracted, which suggests that as little water as possible should be used in cooking the macaroni when strict economy is desirable.

As shown by experiments with healthy men, macaroni has approximately the same digestibility and supplies about the same amount of nutrients, pound for pound on a dry-matter basis, as bread made from straight-grade flour. Consuming either large or small amounts of bread made from durum wheat flour with the macaroni exercised no appreciable effect upon the digestibility of the nutrients and the availability of the energy present.

Macaroni is a highly digestible and nutritious article of diet, corresponding in these respects quite closely to bread, though at ordinary prices it furnishes nutrients at a somewhat greater cost than bread; nevertheless, it may be fairly considered an economical article of diet. Macaroni may be readily combined with other food materials and thus may be used to give variety to the diet.

The durum wheat breakfast food resembled quite closely in composition the macaroni made from similar wheat. It was not quite as thoroughly digested, though its digestibility was fairly high as compared with many vegetable foods. The observed differences in digestibility of the breakfast food and the flour products are undoubtedly due to methods of manufacture, the flour products being rather finely ground and therefore in a condition favorable for the action of the digestive juices.

Taken as a whole the tests show that these American-made macaronies were directly comparable with standard-made goods of European manufacture.

The general summary of results and conclusions on the digestibility and nutritive value of bread is given on pages 53 and 54 of this bulletin.

O

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 157.

A. C. TRUE, Director.

WATER RIGHTS ON INTERSTATE STREAMS:

THE PLATTE RIVER AND TRIBUTARIES.

RESULTS OF INVESTIGATION.

R. P. TEELE, *Editorial Assistant.*

WATER RIGHTS WITHIN THE STATES.

ELWOOD MEAD, *Chief of Irrigation and Drainage Investigations.*

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OFFICE OF EXPERIMENT STATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., May 25, 1905.

Sir: I have the honor to transmit herewith a report on water rights on interstate streams, as illustrated by the Platte River and its tributaries. The report contains a discussion of the result of the investigation, by R. P. Teele, editorial assistant, and a discussion of water rights within the States, by Dr. Elwood Mead, chief of irrigation and drainage investigations. It is recommended that this report be published as a bulletin of this Office.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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WATER RIGHTS ON INTERSTATE STREAMS.

RESULTS OF INVESTIGATION.

By R. P. Teele, *Editorial Assistant.*

THE PLATTE RIVER AND TRIBUTARIES.

The law prescribing the work to be done by this Office originally provided for the investigation of the "laws of the States and Territories as affecting irrigation and the rights of appropriators." Under this provision studies of the laws of several of the States have been made.[a] In 1903 this law was changed by adding to the above clause, "and of riparian proprietors." In response to many requests from the people interested in the control and use of water of the streams flowing east from the Rocky Mountains, a study of the laws affecting the distribution of the water of the Platte River and its tributaries was begun in 1903.

These streams present two questions which have not been extensively dealt with in former reports: (1) What is the relation between rights acquired by "appropriation" and riparian rights on the same stream? and (2) What is the relation between rights to water from the same stream in different States? Since only rights acquired by appropriation are recognized in Colorado and Wyoming, and the rights of riparian proprietors are recognized only in Nebraska, on these particular streams these questions merge into one: What are the relations of rights to water from the Platte River and its tributaries in different States? This report is a discussion of that question.

The accompanying map (Pl. I) shows that the course of the South Platte lies in the States of Colorado and Nebraska; that of the North Platte lies in Colorado, Wyoming, and Nebraska; while the main stream is in Nebraska. A study of the relations between the rights to these streams, therefore, involves the study of the laws and decisions regarding water rights in Colorado, Wyoming, and Nebraska.

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 58, 60, 96, 100, and 124.

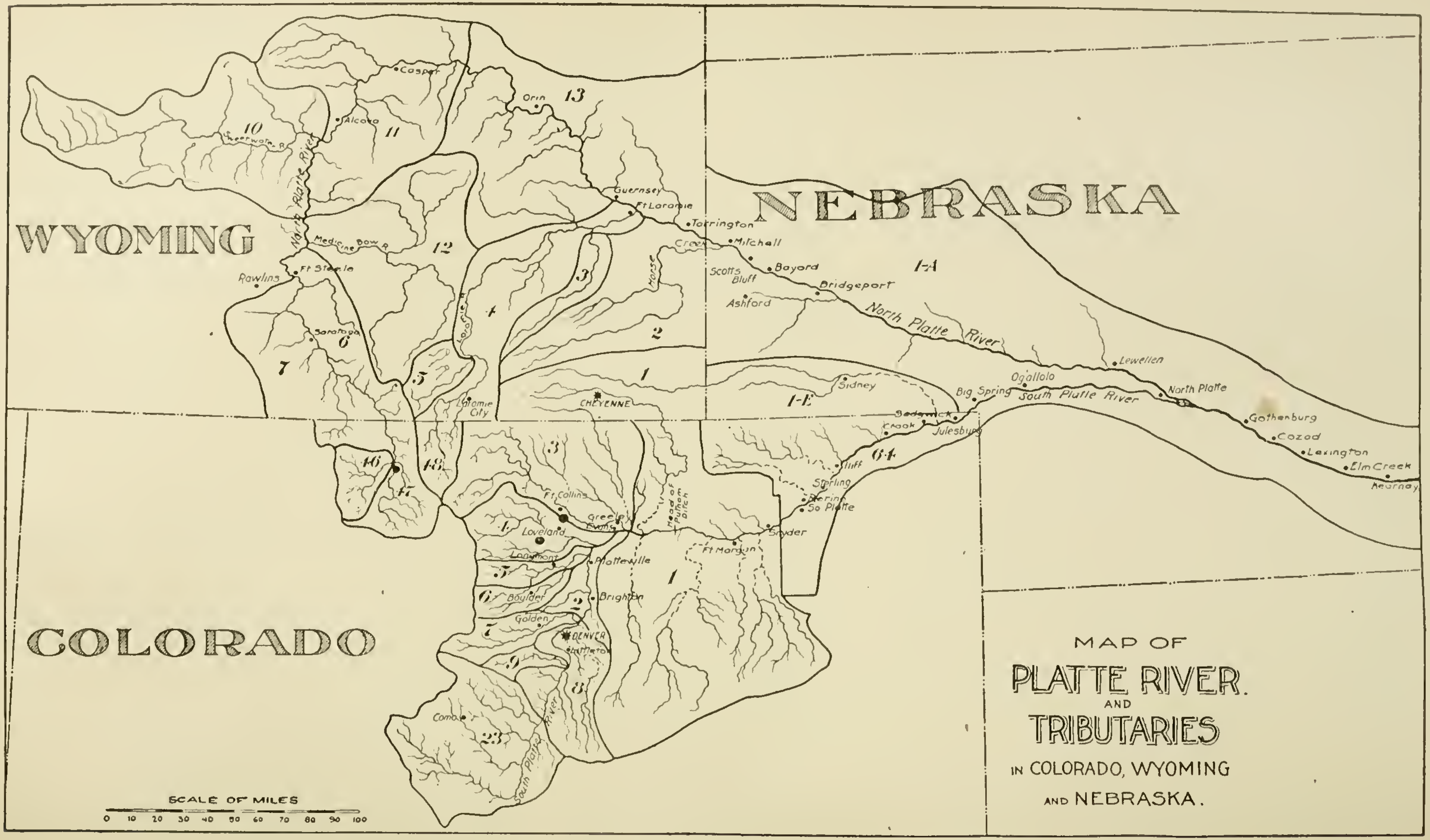
But physical conditions are as important as laws and decisions in determining the relation of rights to water from the same stream, and consequently rainfall, the stream flow, the diversions from the streams, and the return seepage from irrigated lands have all been studied.

The field work on which this report is based was done during the summer of 1903. Mr. W. B. Dunton made a study of the laws and decisions of the three States; Mr. C. E. Tait and Prof. O. V. P. Stout made measurements of return seepage; Mr. Frank Adams collected records of diversions and crop returns, and Mr. W. F. Bartlett collected records of stream flow. Each of these agents made a study of a particular phase of the general question in hand. It was found impracticable to publish the reports entire, but it was decided rather to bring the essential points together in this one discussion. The duty of bringing the results together and determining their bearing on the question being studied was assigned to the writer, to whom the reports of the agents named were submitted. After going over these reports, the writer spent the summer of 1904 in the field collecting such information as seemed to be needed to make the general discussion complete and getting such a personal knowledge of the field covered as is necessary to an intelligent discussion of its problems.

It is not possible to give in the text credit for each fact taken from these reports, and therefore general credit is given here. Most of the information regarding court decisions and rights to the streams is taken from the report of Mr. Dunton, the seepage measurements in Colorado and Wyoming are taken from the report of Mr. Tait, seepage measurements in Nebraska are taken from the report of Professor Stout, the records of diversions and of crop returns are taken from the report of Mr. Adams, and most of the records of stream discharges are supplied by Mr. Bartlett.

PRESENT CONDITIONS.

The controlling factor in the necessity for irrigation along the Platte River is the rainfall. The precipitation is heavier in the mountains, lighter on the plains at the base of the mountains, and gradually increases toward the Missouri. This is shown in the following table, which gives the normal precipitation at stations along the rivers from near the summit of the Continental Divide to the Missouri. The data are taken from the reports of the United States Weather Bureau.


WYOMING
NEBRASKA
COLORADO
MAP OF
PLATTE RIVER.
AND
TRIBUTARIES
IN COLORADO, WYOMING
AND NEBRASKA.
SCALE OF MILES
0 10 20 30 40 50 60 70 80 90 100
Casper
Alcova
Orin
Sweetwater R.
North Platte River
Medicine Bow R.
Rawlins
Ft Steele
Saratoga
Laramie
Laramie City
Guernsey
Ft Laramie
Torrington
Mitchell
Bayard
Bridgeport
Scotts Bluff
Ashford
Horse Creek
CHEYENNE
Sidney
Lewellen
Ogallala
Big Spring
North Platte
South Platte River
Sedgwick
Crook
Julesburg
Iliff
Sterling
Merino
So Platte
Snyder
Ft Morgan
Head of Putnam Ditch
Ft Collins
Greeley
Evans
Loveland
Longmont
Platteville
Boulder
Brighton
Golden
DENVER
Littleton
Como
South Platte River
Gothenburg
Cozad
Lexington
Elm Creek
Kearney
1
1
1
1-A
1-E
2
2
3
3
4
4
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5
6
6
7
7
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48
64

Platte River and Tributaries in Colorado, Wyoming, and Nebraska.

Normal annual precipitation at stations along Platte River and tributaries.

Station.	Altitude.	Precipitation.
South Platte:	*Feet.*	*Inches.*
Longs Peak	8,600	16.47
Moraine, Colo	7,900	16.94
Cheesman	6,782	14.62
Denver	5,291	14.49
Laporte	5,069	15.29
Fort Collins	4,994	14.68
Greeley	4,637	11.92
Fort Morgan	4,000	11.74
North Platte, Nebr	2,821	18.27
North Platte:		
Saratoga, Wyo		14.08
Laramie, Wyo	7,188	9.85
Alcova, Wyo	5,450	9.44
Fort Laramie, Wyo	4,270	11.19
Gering, Nebr	3,902	15.00
Bridgeport, Nebr		16.09
North Platte, Nebr	2,821	18.27
Platte:		
Lexington	2,385	22.09
Kearney	2,147	26.89
Grand Island	1,861	28.57
Fremont	1,203	30.76
Plattsmouth	968	32.60

The facts given in the table are shown graphically in the diagrams (figs. 1 and 2). In these diagrams the horizontal scale represents distance in miles; the vertical scale represents altitude and depth of precipitation. In each curve the altitude steadily diminishes, while the precipitation is high in the extreme altitudes, drops down near the base of the mountains, then gradually increases to the east, the decrease in altitude and the increase in precipitation being remarkably uniform from the base of the mountains east. Throughout a large portion of the area the rainfall is insufficient for the needs of maximum crops.

A common assumption is that irrigation is necessary for successful agriculture where the annual rainfall is less than 20 inches. In a general way the assumption is borne out by agricultural practice along the Platte. Laporte is just at the foot of the mountains, and no agriculture is attempted without irrigation. North Platte is at the other edge of the distinctly arid zone, and there many farms are regularly irrigated except during years when the rainfall is above normal, although some are "dry farmed." At Lexington, where the rainfall is just over the 20-inch mark, a canal covers a large area of farm land, but only a part of the farmers use water, and the canal management is carrying on a campaign of education to demonstrate to the people the benefits of irrigation. At Kearney, where the rainfall is a little greater, a large canal was constructed, but is not regularly used for irrigation. Irrigation is practiced all along the North Platte, and at none of the stations on that stream does the rainfall equal 20 inches. In general, then, the distinctly

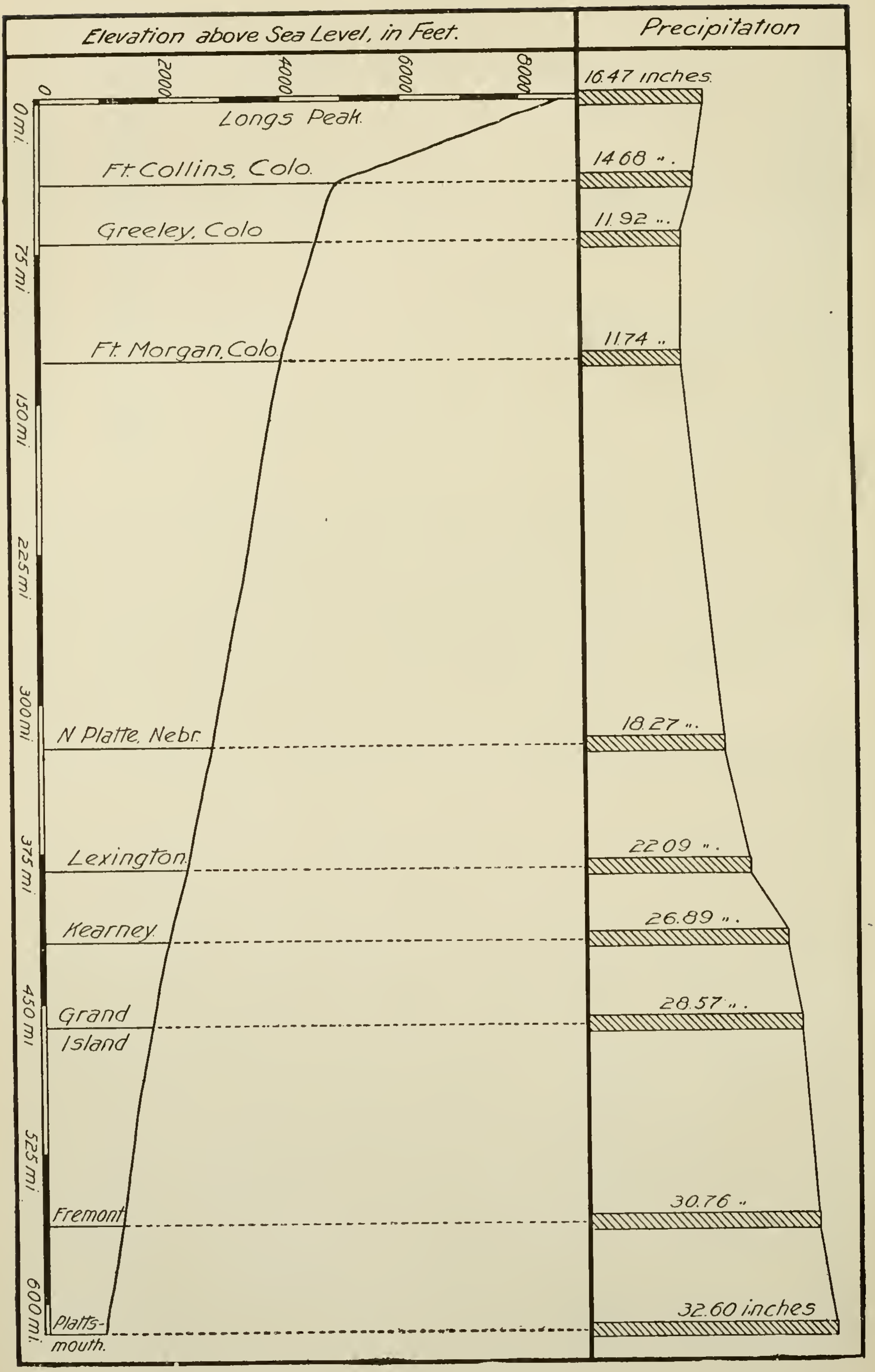

Fig. 1.—Altitude and precipitation at points in valley of South Platte and Platte rivers.

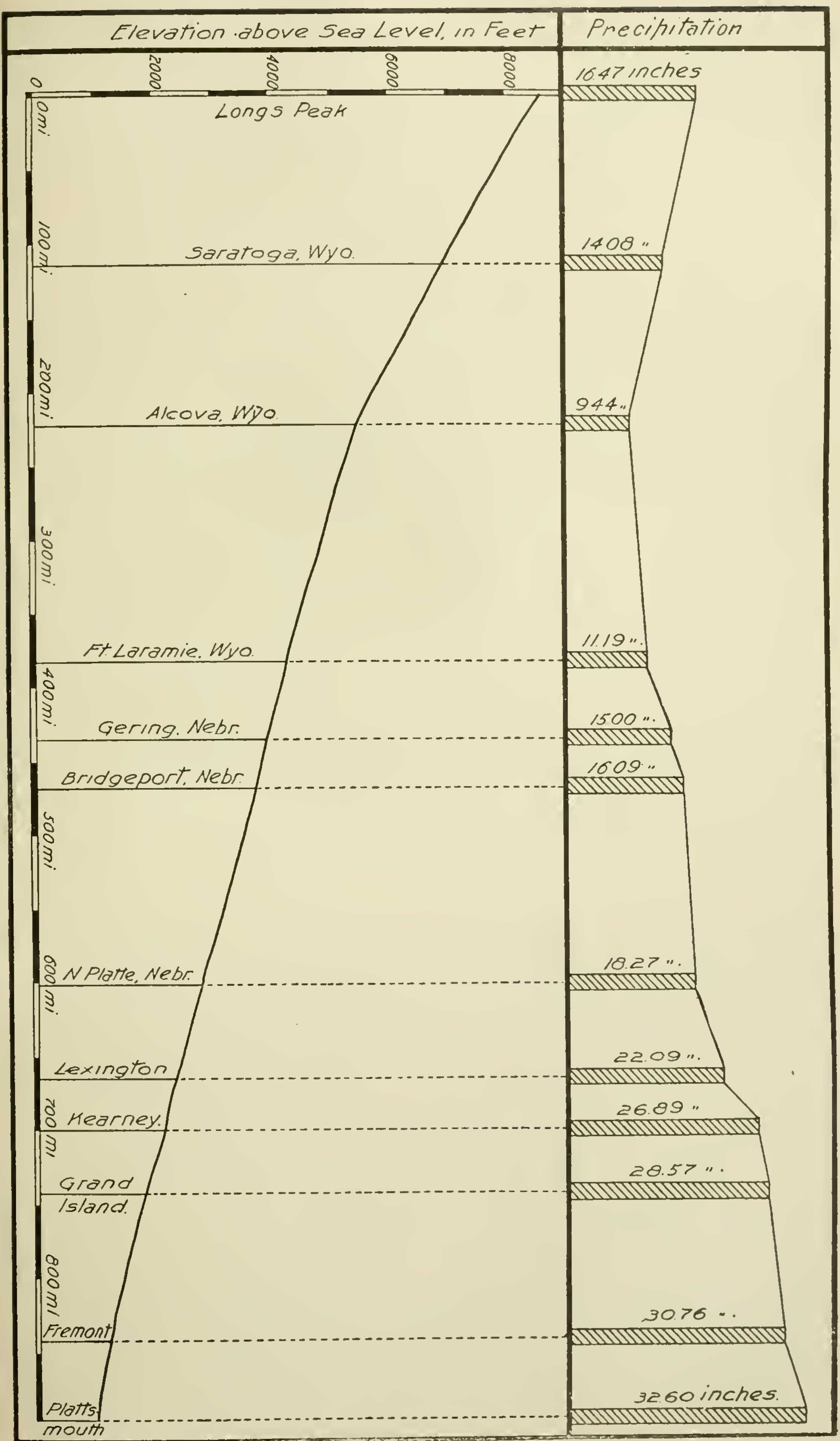

FIG. 2.—Altitude and precipitation at points in valley of North Platte and Platte rivers.

arid zone extends from the mountains to North Platte, Nebr. East of North Platte some farms are irrigated, while others are not, the proportion of irrigated to unirrigated farms gradually diminishing to the east; that is, all the agricultural lands along the branches of the Platte River in Colorado and Wyoming require irrigation. Those in Nebraska, as far east as North Platte, are in the same condition, while those east of North Platte have less need of it.

SOUTH PLATTE AND TRIBUTARIES.

The water supply of the South Platte Valley comes almost entirely from streams fed by the snows and rains in the mountains, and is largest in the early summer and smallest in the late summer. The South Platte itself is a mountain stream, and receives also the discharge of a number of other streams coming from the eastern slope of the Rocky Mountains. The flow of these streams at stations near the mountains where records have been kept is shown in the following table:

Mean monthly flow of South Platte River and tributaries.

Stream.	April.	May.	June.	July.	August.	September.
	Cu. ft. per sec.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
South Platte at Deansbury	432	747	669	497	276	181
Bear Creek at Morrison	123	156	160	98	91	47
Clear Creek at Forks Creek	120	526	832	495	221	113
Boulder Creek near Boulder	91	359	507	321	149	64
St. Vrain Creek near Lyons	164	363	625	376	181	91
Big Thompson River at Arkins	151	501	808	452	207	103
Cache la Poudre above Fort Collins	499	1,495	1,985	781	320	175
Total	1,580	4,147	5,586	3,020	1,445	774

All these tributaries are located on the north and west side of the river. There are in addition a number of torrential tributaries on the south and east sides, which carry large volumes of water during heavy storms. Below the mouth of the Cache la Poudre several torrential streams come in on both sides of the river. These are shown on the map (Pl. I). These streams are of little value for irrigation without storage, since the flow is so uncertain and lasts but a few hours or days at a time; but with storage they become valuable sources of irrigation water. Reservoirs have been built on some of these streams and more will probably be built.

There is considerable irrigation above the points of measurement on the streams given in the table. There are small tributaries for which no measurements are available, and the measurements for the streams given cover different periods. The volume given for each month for each stream is the average of whatever measurements are available. Therefore, the table is not to be taken as exact, but it gives a general idea of the average available water supply for the lands in the South Platte Valley. The average total supply for the period from April to September, inclusive, is 2,765 cubic feet per second. Against this supply, rights[a] aggregating 30,597.47 cubic feet per second have been recognized by public authorities in Colorado and Nebraska. (See p. 39.) That is, the rights to be supplied by this river system are more than ten times as great as the average flow of the streams. This statement of averages does not, however, give a correct idea of the relation between water supply and water rights. Many canals were built with the full understanding that water could be obtained only at intervals, and the frequency and duration of floods are of more importance to their owners than average flows. The conditions are more correctly represented by the tables given below, showing the maximum, minimum, and mean discharges of the South Platte at Deansbury and of the Cache la Poudre above Fort Collins, with the differences between these discharges and the sum of all decreed rights to water.

The table which follows gives the maximum, mean, and minimum flows of the South Platte at Deansbury, Platte Canyon, or South Platte for the years 1890–1892 and 1896–1903. The maximum for each month is the greatest discharge reported for that month during the period covered, rather than the mean maximum. The minimum is obtained in the same way. The sum of the decreed rights to water from the South Platte between the point of measurement and Denver is approximately 1,913 cubic feet per second. The differences between this volume and the discharges of the stream are shown in the last column of the table.

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[a] Rights to water are theoretically based on use, and no one has a right to more water than he has put to use. However, the courts have decreed to some parties rights to more water than they have used and more than their ditches can carry. On the basis of the decrees the parties have these rights, while on the basis of the theory the rights do not exist. The figures given here are based on the decrees. (See pp. 26–39.)

Discharge of South Platte River at Deansbury, Platte Canyon, or South Platte, 1890–1892 and 1896–1903.

Month.	Stage.	Discharge.	Greater (+) or less (−) than rights.
		Cubic feet per second.	*Cubic feet per second.*
April	Maximum	2,445	+ 532
	Mean	432	−1,481
	Minimum	98	−1,815
May	Maximum	2,685	+ 772
	Mean	747	−1,166
	Minimum	63	−1,850
June	Maximum	2,175	+ 262
	Mean	669	−1,244
	Minimum	60	−1,853
July	Maximum	2,195	+ 282
	Mean	497	−1,416
	Minimum	55	−1,858
August	Maximum	1,365	− 548
	Mean	276	−1,637
	Minimum	21	−1,892
September	Maximum	764	−1,149
	Mean	182	−1,731
	Minimum	57	−1,856

The table shows that while the average flow for no month equals one-half of the sum of the decreed rights, at times during the months of April, May, June, and July there has been more than enough water to supply all decreed rights, leaving some water to flow down to lower ditches. On the other hand, the table shows that there have been times in each month when the flow of the stream does not equal one-twentieth of the decreed rights in this one section. Some of the ditches farther down on the river have decreed rights which must be supplied from this flow, but the river receives some tributaries below, so that the table does not present the exact situation, although it gives a good illustration of the general condition on the South Platte. At times there is more water than all the ditches can divert; at other times only a few can be supplied, with the average far below the sum of the rights.

The following table gives similar facts for the Cache la Poudre. The record extends from 1894 to 1903, inclusive. The sum of decreed rights to the river below the point of measurement, where the river leaves the mountains about 12 miles above Fort Collins, is 3,988 cubic feet per second.

Discharge of Cache la Poudre River above Fort Collins, 1894–1903.

Month.	Stage.	Discharge.	Greater (+) or less (−) than rights.
		Cubic feet per second.	*Cubic feet per second.*
April	Maximum	2,934	−1,054
	Mean	521	−3,467
	Minimum	74	−3,914
May	Maximum	5,100	+1,212
	Mean	1,495	−2,493
	Minimum	200	−3,788
June	Maximum	4,376	+ 388
	Mean	1,985	−2,003
	Minimum	559	−3,429
July	Maximum	2,701	−1,287
	Mean	776	−3,212
	Minimum	200	−3,788
August	Maximum	974	−3,014
	Mean	320	−3,668
	Minimum	91	−3,897
September	Maximum	488	−3,500
	Mean	180	−3,808
	Minimum	43	−3,945

This table shows that at times in May and June the discharge of the Cache la Poudre is large enough to supply all decreed rights and leave some water to pass down the stream. The mean for June equals almost exactly one-half of the decreed rights, while the minimum for June, the month of largest flow, is about one-seventh of the sum of the rights. The minima for May and July are about one-twentieth of all the rights, the minimum for August is about one forty-fourth of the rights, that for April is about one fifty-fourth, and that for September about one ninety-third.

The areas irrigated and the number of ditches and reservoirs along the South Platte and tributaries in Colorado, as reported to the State engineer, are given below. The areas are stated in round numbers and are only approximate. It is the opinion of the State engineer that they are over rather than under the truth. For administrative purposes the State is divided into districts, as shown on the map. (Pl. I.) The areas are given by districts.

Ditches, reservoirs, and areas irrigated on South Platte and tributaries in Colorado.

District.	Ditches.		Reservoirs.		Area irrigated.
	Number.	Length.	Number.	Capacity.	
		Miles.		*Acre-feet.*	*Acres.*
No. 23	235	311	----	----	67,213
No. 8	95	291	20	----	23,781
No. 9	19	66	20	15,076	8,193
No. 7	32	265	----	----	92,895
No. 6	40	281	16	4,000	72,081
No. 5	36	267	32	11,506	85,513
No. 4	17	158	35	44,320	91,922
No. 3	48	352	35	103,257	174,885
No. 2	26	289	6	7,426	68,762
No. 1	34	242	2	----	71,640
No. 64	17	----	----	----	35,953
Total	600	2,522	166	185,585	792,838

There is little irrigation along the South Platte in Nebraska. The report of the State board of irrigation for 1901–2 shows 14 ditches, with a total length of 107 miles, covering 43,300 acres. No statement is given showing the part of the land under ditch which is irrigated, but it does not exceed one-half. There are no reservoirs along this section of the river.

None of the above figures, showing water supply, water rights, number of ditches and reservoirs, and acreages irrigated should be taken as exact, but they give a general view of conditions in the South Platte Valley. In the upper districts along the main river agriculture is not highly developed, but large areas of hay and grain are raised. In the vicinity of Denver, both on the main stream and the tributaries to the north of Denver, large areas are devoted to small fruits and vegetables. To the north of this, on the tributaries, is the section where the storage of water has made possible the raising of potatoes and sugar beets, and increased yields of alfalfa.

Below these tributaries on the main stream the stage of development declines steadily, not only throughout the course of the stream in Colorado, but on to its mouth in Nebraska. But the construction of reservoirs and the accompanying advance in the values of crops raised is gradually progressing down the stream and may be expected to continue to do so.

Records of the diversions of water by the principal ditches in seven out of ten districts, Nos. 3, 4, 5, 7, 9, 2, 1 (see map, Pl. I), in Colorado were obtained by Mr. Adams in 1903, and crop returns under five ditches, covering 24,329 acres, were also secured. Mr. Adams sums up his results as follows:

> During the irrigation season of 1903, the farmers of Colorado used in irrigation practically the entire flow of South Platte River and tributaries, besides diverting a small supplemental supply from the basins of Grand, North Platte, and Laramie rivers. During the preceding nonirrigating period and after the irrigation season of 1903, the flow of the principal tributaries was almost wholly diverted into reservoirs, the total amount stored for use in 1903 having been over 200,000 acre-feet. The seasonal mean of the daily diversions by the principal ditches of the South Platte system except those in district 23, in part estimated, was about 2,600 cubic feet per second. Running continuously from May through September, this amounted to 788,996 acre-feet, and at the average return per acre-foot used under five representative ditches in South Platte basin made possible a gross return of $4,623,517. Adding to this the return made possible by the 200,000 acre-feet of stored water figured at the same rate, which is low for stored water, the total return to the farmers of Colorado situated in this basin was over $5,500,000. The irrigation season began in April in some of the districts and lasted through November on the main South Platte below Denver.

To this should be added the returns from 122 small ditches scattered throughout all the districts. The ditches for which crop returns were secured are not those where the highest returns are secured and were probably below the average; the total given by Mr. Adams is therefore considerably less than the actual return secured from the irrigated farms in the South Platte Valley in Colorado. This complete utilization of the water supply and the raising of high-priced crops have been made possible only by the development of methods of distribution and exchange which are probably not equaled anywhere else in the United States.[a]

NORTH PLATTE AND TRIBUTARIES.

The North Platte River rises in North Park, Colorado, between the Medicine Bow Mountains on the east and the Park Range on the west, which, with the Continental Divide on the west, form a horseshoe-shaped area comprising about 1,700 square miles in Colorado. The valley in this section has a general altitude of about 8,000 feet, and the mountains surrounding it rise to 10,000 to 12,000 feet. The streams draining these mountains unite in the center of North Park to form the North Platte River. Near the Colorado-Wyoming line the river enters a succession of canyons separated by stretches of rolling hills. This formation extends for about 20 miles, beyond which the river enters a rolling country. The hills are not so high as those farther south and occasionally recede from the stream, leaving areas of bottom land varying from 10 to 1,000 acres in extent. These bottom lands are irrigated, usually not from the river itself, but from mountain tributaries. Beaver, French, Brush, Cow, and Encampment creeks enter the river in this section. Farther down the valley broadens until it reaches a width of 1 to 3 miles on the west side and an average of about 4 miles on the east. This valley extends for 50 miles to the Union Pacific Railroad at Fort Steele. In this valley the river receives the discharges of Jack, Sage, Spring, and Pass creeks. The estimated area which can be reclaimed by irrigation in this valley is about 125,000 acres. The river receives its greatest perennial supply from these tributaries entering it in the section above Fort Steele. Irrigation is practiced to some extent in the valleys of these tributaries.

From Fort Steele the river flows through precipitous hills for about 35 miles to the Seminole Mountains. The country on both sides is badly broken, and is used only for grazing. In this section the river receives the discharge of the Medicine Bow River, which rises in the Laramie Mountains. Irrigation is practiced along the course of the Medicine Bow. From the mouth of the Medicine Bow to the mouth of the Sweetwater River the land along the North Platte becomes more and more sandy, until vegetation practically disappears. From the mouth of the Sweetwater the river still flows through broken rolling hills until it reaches Sevenmile Canyon. The walls of this canyon rise almost perpendicularly to a height of about 2,000 feet above the river bed. Beyond Sevenmile Canyon the river flows through another stretch of hilly country, then enters the Alcova Canyon. From Alcova to Casper the river is bordered by a high, level plateau. Between Alcova and Casper, Bates Creek, Poison Spider Creek, and Casper Creek enter the North Platte. These streams are not perennial, but are used for irrigation in the spring. There is almost no irrigation from the North Platte between Fort Steele and Casper, and little land which can be irrigated. Narrow strips of bottom lands along the tributaries are, however, irrigated, and this area is being constantly extended. From Casper to Orin the river flows in a wide valley, winding back and forth across this valley in a sandy bed. In times of low water it is divided into several channels.

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 92, 118, and 134.

Surveys have been made for a number of canals to cover parts of this valley, but only one has been completed, and it is now out of repair. This section, however, affords some of the best examples of irrigation in the Platte Valley. Many ditches divert the waters of the tributaries of the Platte, reservoirs have been built, and the complete utilization of the water supply in the near future is assured. In this section, between Casper and Orin, Big Meadow, Deer, Box Elder, La Prelle, Wagon Hound, and La Bonte creeks enter the river. These streams are all used for irrigation, and supply very little water to the main stream. Below Orin on each side of the river for a distance of 5 or 6 miles there is considerable irrigated land, which is watered by three ditches, the largest of these being about 10 feet on the bottom and 2 feet deep. Ten miles below Orin the river enters broken country, with occasional stretches of land which could be reclaimed by lifting water from the river. The valley broadens again at Guernsey, this valley extending to and beyond the State line. Several good-sized ditches take water from the river in this section and irrigate considerable areas of land. Other canals which are under construction will irrigate between 25,000 and 50,000 acres. Elkhorn, Horseshoe, Cottonwood, and Rawhide creeks and the Laramie River enter the river in this section.

LARAMIE RIVER.

The Laramie River rises in northern Colorado in the vicinity of the other streams which go to form the North Platte and flows through Wyoming in a course generally parallel to the North Platte, the two coming together near the Wyoming-Nebraska line. There is little irrigation along the Laramie in Colorado; some of its water is, however, carried over the divide separating its headquarters from those of the Cache la Poudre, and is used in the valley of the latter stream. In Wyoming the Laramie is extensively used for irrigation. Not far from the Colorado-Wyoming line it enters the Laramie Plains, which comprise an extended area of high level land, much of which is under ditches taking water from the Laramie. Below the Laramie Plains irrigation is confined to narrow strips bordering on the stream. The Wheatland Flats, which lie between Sybile and Chugwater creeks, where some 65,000 acres is irrigated, are served by water taken out of the Laramie through a tunnel into Sybile Creek.

The areas irrigated from the tributaries of the North Platte in Wyoming are given with close approximation in the order establishing rights to water and in the subsequent certificates of appropriation issued by the board of control. These amount in the aggregate to 360,000 acres. It has been estimated that about 53,000 acres are irrigated from the North Platte itself.

THE NORTH PLATTE IN NEBRASKA.

The stream throughout its course in Nebraska is bordered by a valley of considerable width, back of which are the high plains, where the areas which can be reclaimed are limited only by the water supply. One large canal heads immediately above the Wyoming-Nebraska State line and carries water to land in Nebraska. Two other large canals head immediately east of the State line in Nebraska. Lands immediately adjoining the river throughout its length to the junction with the South Platte are under ditch, except for small areas where the hills come down to the river bank. The largest irrigated areas lie in the section from the State line to Bridgeport, a distance of about 75 miles, and in the point of land between the two rivers for a distance of about 20 miles west of the junction. One canal taking water from the North Platte crosses the South Platte and covers land on the south side of that stream.

Below the junction the valley on the north side of the river slopes gradually up to the hills, and these hills are low, so that canals can be easily built to cover land at long distances from the stream. On the south side the hills are higher and come closer to the river. A number of large ditches have been built to cover the lands on the north side as far as the city of Kearney, which is about 90 miles below the junction. Short canals cover some land on the south side.

The report of the State board of irrigation of Nebraska for 1901–2 states that the canals diverting water from the North Platte, in Nebraska, have an aggregate length of 780 miles and cover 338,220 acres. The canals on the main stream below the junction have an aggregate length of 296.5 miles and cover 179,440 acres. Not all of this land under ditch is irrigated, but it is impossible to make any estimate as to what portion is watered. Along the North Platte irrigation is necessary for the raising of crops, so that a considerable portion of the land under ditch is watered. Below the junction crops can be raised without irrigation in most years, and some of the large canals, although they cover extended areas, supply very little water for irrigation.

Along the North Platte, in Colorado, the chief crop is native hay. Owing to altitude few other crops can be raised. Hay was the first crop grown in Wyoming, also, but in recent years diversified farming has been constantly gaining ground, until from Casper to the State line the crops are of the same general character as those grown along the South Platte. Along the Laramie, in Colorado, and on the Laramie Plains the crops irrigated are chiefly native hay and alfalfa, although some grain and vegetables are raised on the Laramie Plains. At Wheatland general farm crops are grown, including alfalfa, grain, corn, and potatoes. Experiments have been made with sugar beets, showing that they can be successfully grown here. In Nebraska general farm crops and some small fruits are raised. Potatoes have become an important crop in this section, and some sugar beets also are grown. Along the main river below the junction large areas of corn are raised, usually without irrigation, but in some seasons corn is watered.

It will be seen that conditions along the North Platte differ widely from those on the South Platte. Near the base of the mountains on the South Platte and its tributaries agriculture has reached a very advanced stage of development, while along its lower reaches the lands are now being reclaimed, and low-priced crops are chiefly raised. On the upper sections of the North Platte the low-priced crops are grown, while the more highly developed agriculture is found on the lower reaches of the stream. Nowhere on the North Platte, however, has agriculture reached such an advanced stage as is found in places on the South Platte and its tributaries.

The areas irrigated from the North Platte and tributaries are reported as follows:

Areas irrigated from the North Platte River and tributaries.

	Acres.
Colorado	157,965
Wyoming	413,000
Nebraska	338,220
Total	909,185

On the main river below the confluence the area under ditch is reported by the State board of irrigation as 179,440 acres.

Few records of the flow of the North Platte and its tributaries have been made. No records of the flow in Colorado have been kept. A record was kept for a part of the season of 1903[a] at Saratoga, Wyo. This is given as follows:

Discharge of North Platte River, at Saratoga, Wyo., 1903.

	Cubic feet per second.
June:[b]	
Maximum	8,000
Mean	6,306
Minimum	3,580
July:	
Maximum	2,912
Mean	1,236
Minimum	465
August:	
Maximum	465
Mean	300
Minimum	220
September:	
Maximum	754
Mean	518
Minimum	206
October:	
Maximum	700
Mean	614
Minimum	490
Average	1,490

This does not, however, represent the supply for the lands below Saratoga, as below that point the river receives many tributaries for which no records are available.

Since 1894 the Wyoming State engineer's office has kept records showing the flow of the North Platte at Douglas, Orin, or Guernsey. Douglas and Orin are not far apart, and Guernsey is about 60 miles below Douglas. In the table which follows the measurements are averaged as if all were made at the same point. It is not believed that the discharge varies enough between these points to introduce any considerable error. Laramie River and Horse Creek enter the North Platte below Guernsey, but the present and prospective storage of the flow of these streams makes the supply at Guernsey a fair approximation of what is available for future extension of the irrigated area along the North Platte below that point. Rights below this point aggregate 11,172.66 cubic feet per second, a little less than three times the average flow of the stream for the irrigation months. This includes rights to water from the main Platte, since it receives its principal supply from the North Platte.

In the table the maximum, minimum, and mean discharges of the river are given, with a column showing the difference between each discharge and the sum of the decreed rights:

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[a] Discharge table made from data supplied by A. J. Parshall, U. S. Geological Survey.

[b] 21 days, 10th to 30th, both inclusive.

Discharge of North Platte River at Douglas, Orin, or Guernsey, Wyo., 1894–1903.

Month.	Stage.	Discharge.	Greater (+) or less (−) than rights.
		Cubic feet per second.	*Cubic feet per second.*
April	Maximum	13,420	+ 2,247
	Mean	3,728	− 7,445
	Minimum	600	−10,573
May	Maximum	19,093	+ 7,920
	Mean	7,718	− 3,455
	Minimum	2,500	− 8,673
June	Maximum	22,935	+11,762
	Mean	8,767	− 2,406
	Minimum	1,634	− 9,539
July	Maximum	17,770	+ 6,597
	Mean	2,602	− 8,571
	Minimum	600	−10,573
August	Maximum	2,400	− 8,773
	Mean	772	−10,401
	Minimum	220	−10,953
September	Maximum	1,085	−10,088
	Mean	523	−10,650
	Minimum	80	−11,093

The table shows that at times during the months of April, May, June, and July there is more than enough water to supply all decreed rights in full, the highest flood discharge for June being more than double the sum of these rights. In no month does the average flow equal the sum of the rights, although the average for June approaches it. The serious shortage occurs in August and September. The table shows that there is still a large supply of water available for storage during the summer, in addition to the winter flow.

With decreed titles to water from the South Platte and tributaries aggregating more than ten times the supply at the foot of the mountains, and from the North Platte and Platte amounting to about three times the average supply, it is evident that all can not receive all the water to which they are nominally entitled. It is this scarcity of water as compared to the claims which makes the relation of rights a matter of importance. When there is not water enough for all, who shall receive what there is? Have the people of one State a better right to this water than those of another, or are their rights to be determined regardless of State lines? To what extent does use by parties on one section of a stream deplete the supply for others on a lower section? Or, to make it specific, what effect does the use of water of the South Platte in Colorado have on the flow of the stream in Nebraska? What effect has the use of water from the North Platte in Colorado on the supply in Wyoming? And what effect has the use of water from the North Platte in Wyoming on the supply for holders of rights in Nebraska? One further question is rendered important by the scarcity of water. When it is decided who is entitled to the water, how are their rights to be protected? The answering of these questions requires a study of the existing systems of water rights in the States, and of the character of the streams.

RIGHTS TO WATER.

In the arid region irrigation began before the adoption of any laws regarding the diversion of water from streams and its use in agriculture. As a result, the irrigation codes of the States have had a gradual growth, laws being enacted from time to time in response to changing conditions as the use of the streams for irrigation has progressed, and decisions defining the nature of rights being handed down as new conflicts have arisen. This process is still going on, and, therefore, there are many things regarding rights to water which can not be considered settled. However, some principles have been recognized in the constitutions and laws of the States, and others have been decreed and so often reaffirmed by the courts that they may be considered finally settled.

The early settlers found that they needed to put water upon the land in order to grow crops. They therefore built ditches and took the water from the streams without formality and without restriction. This came to be called appropriation of water, and the right to take water in this way was called the right of appropriation.

As diversions were made, the time came when new diversions lessened the supply of some of those who had already used water. Simple justice demanded that the person who had dug a ditch, improved his land, and used water be protected in that use, since taking the water away from him destroyed the value of his property. The superiority of the right of the first users over the rights of those making later diversions was recognized by common custom and by laws, and is known as the principle of priority.

On the other hand, justice and the public welfare demand that the holder of the early right shall take only such water as he needs, leaving as large a supply as possible for later comers. It is, therefore, required that the water taken from streams be put to a beneficial use and not wasted.

The right of appropriation and the principles of priority and beneficial use have been recognized by the States of Colorado, Wyoming, and Nebraska. Each of these States has also recognized the necessity of providing for the distribution of the water of its streams to those entitled to it, and has provided officials for this purpose. These general features of the laws have been fully discussed in previous bulletins of this Office.[a]

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 58, 60, 70, 96, 118, and 140.

RIGHTS TO WATER FROM SOUTH PLATTE AND TRIBUTARIES.

Preliminary to enumerating the rights to water from the South Platte which have been acquired in the States of Colorado and Nebraska it may be well to state briefly the status and nature of rights in the two States. In Colorado rights are acquired by diversion and use without public supervision, are defined by the courts, and when defined and after the expiration of the two years allowed for appeal are considered absolute rights to the quantity of water stated in the decrees. (See p. 92.) These rights can be sold and transferred under direction of the court, if others are not injured by the transfer. (See p. 88.) This quantity, as a rule, bears no relation to the area irrigated or the needs of the holder of the right. (See p. 92.) Rights are enforced by State officials. Rights in Nebraska have been acquired in the same way as in Colorado up to the enactment of the law of 1895; since that time they have been acquired by application to the State board of irrigation, and the diversion and use of the water, are defined by the board or the courts, and enforced by State officials. The right is to sufficient water for the land to be irrigated, not to a fixed quantity of water; is attached to a particular tract of land, and can not be transferred to other land. (See p. 87.) The facts given in the following pages regarding the water-right decrees, both as to the nature of the decrees and the quantities of water decreed, are taken from the report of W. B. Dunton.

COLORADO.

District 23.—District 23 comprises the country which is known as South Park, which is drained by the headwaters of the South Platte. (See map, Pl. I.) The decree which governs practically all the rights in this district was rendered in August, 1889. It includes ditches with priorities dating from 1861 to 1888, and covers all the rights which have been decreed, with the exception of a few small ones amounting to 105.62 cubic feet per second, which have been adjudicated since. The decree awards the water to the various ditches on the basis of their respective capacities. Each appropriator was awarded unconditionally the full amount of water which he claimed his ditch would carry, regardless of whether he had applied that amount to a beneficial use. No attention was paid to the areas of land actually irrigated, but statements were given of the areas "to be watered" by the ditches; however, the amounts of water awarded bore no relation to the acreages stated. In almost all cases about twice, and in many cases from three to ten times, the amount of water which the ditches would actually carry were decreed. Not long after the adjudication 40 of the ditches whose rights were adjudicated were gauged by an engineer. Only 8 out of the 40 had capacities equal to the right decreed them. The combined capacity of these ditches as measured was 543.97 cubic feet per second, while they were decreed rights to 1,358.95 cubic feet per second. The total amount of the rights as finally established by the decree probably bears about the same proportion to the total amount of water which the ditches could carry.

District 23 is the highest district on the South Platte River. Rights in this district are theoretically subject to prior rights in all the lower districts on the river—districts 8, 2, 1, and 64—but so far no attempt to close down these ditches has been made, owing in part to the belief that the water is used very largely on hay lands close to the river and returns so quickly to the river that its use has little effect on the flow, and in part to the opposition on the part of the holders to any regulation by the State officials. The table which follows shows the total amount of the rights acquired in each year and the sum of the rights antedating these in the lower districts to which rights in district 23 are theoretically subject:

Rights to water in district 23 and prior rights in lower districts.

Year.	Rights in district 23.		Prior rights in lower districts.	Year.	Rights in district 23.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic fect per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1861	39.49	39.49	96.77	1880	150.35	1,902.29	5,115.31
1866	53.46	92.95	660.82	1881	412.75	2,315.04	5,212.81
1867	106.56	199.51	772.33	1882	446.61	2,761.65	5,659.02
1868	26.32	225.83	803.60	1883	49.87	2,811.52	6,692.29
1871	10.00	235.83	938.06	1884	241.71	3,052.23	6,847.69
1872	12.70	248.53	1,417.70	1885	186.48	3,238.71	6,967.69
1873	97.93	346.46	1,534.18	1886	157.21	3,395.92	7,317.69
1874	144.50	490.96	2,117.36	1887	163.87	3,559.79	7,479.19
1875	227.11	718.07	2,315.86	1888	679.27	4,239.08	7,499.19
1876	299.71	1,017.78	2,688.50	1889	20.00	4,259.08	8,104.19
1877	206.89	1,224.67	2,952.07	1890	30.00	4,289.08	8,301.79
1878	166.91	1,391.58	3,076.75	1891	30.00	4,319.08	8,304.79
1879	360.36	1,751.94	3,386.21				

The total amount of the rights in this district is 4,319.08 cubic feet per second decreed to 219 ditches. No records of the flow of the streams supplying this district or of the diversions made in the district have been kept. The total area irrigated, as reported by the water commissioner for 1903, was 67,213 acres, or about 16 acres per cubic foot per second of the amount decreed.

District 8.—District 8 includes the section of the South Platte River between the mouth of Platte Canyon and the mouth of Clear Creek and the tributaries of the Platte in this section. The first decree in this district was rendered in 1883 and governs the rights of all ditches which take water from the South Platte River itself. A later adjudication took place in 1890, by which a few ditches with late priorities and a number of reservoirs all supplied from tributaries had their rights defined. The original decree unconditionally awarded each ditch a volume of water equaling its full capacity. The later decree also computed rights on the basis of the capacities of the ditches. Since 1890 a number of petitions to have rights defined have been brought by parties who neglected to come into the general adjudication. The court has denied none of these petitions, but has awarded the volumes claimed. About 15 ditches have obtained such decrees, giving them priorities dating from 1862 to 1889. A number of the reservoirs in this district have decreed rights also.

Rights in this district are subject to prior rights in districts 2, 1, and 64. The following table gives the decreed rights in district 8, by years, and the sum of the prior rights in the lower districts:

Rights to water in district 8 and prior rights in lower districts.

Year.	Rights in district 8.		Prior rights in lower districts.	Year.	Rights in district 8.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1860	67.00	67.00	----------	1868	32.00	354.38	469.71
1861	54.30	121.30	----------	1873	40.00	394.38	1,250.59
1862	22.50	143.80	29.77	1878	285.83	680.21	2,708.96
1863	34.00	177.80	77.65	1879	1,184.00	4,864.21	2,732.59
1864	79.01	256.81	167.21	1882	42.95	1,907.16	3,821.40
1865	34.30	291.11	224.06	1883	5.40	1,912.56	4,811.72
1867	31.27	322.38	469.71				

There are in this district 95 ditches, with total decreed rights to 1,912.56 cubic feet per second. To supply this water in the season of 1903 the maximum flow of the river at Platte Canyon was 1,284 cubic feet per second for a single day. There was 300 cubic feet per second or over in the river on only thirty-one days and 200 cubic feet per second or over on only seventy-three days. Only two ditches received water throughout the seven months of the irrigating season. Five received some water in six months, and one, the largest ditch in the district, received water on only eleven days out of the season. Many of the ditches in this district have rights prior to those in district 23 above, but no effort has been made to close ditches in the upper district to supply ditches in district 8.

In addition to the water decreed to ditches as stated above, many reservoirs have decreed rights. These can be filled only outside the irrigation season or when there is more water than is needed for direct irrigation. No statement of the total quantity of water to be stored by these reservoirs can be made, owing to the fact that not all the decrees give the capacities of the reservoir.

District 9.—District 9 comprises the drainage area of Bear Creek and its tributaries. The decree governing rights in this district was rendered in 1883. Each ditch was decreed the amount of water the referee found to be its full carrying capacity. These findings of the referee were based on measurements made by a civil engineer employed for that purpose, so that there is probably not the same excess in rights decreed over actual capacities that there is in other districts. The ditches on Bear Creek can be supplied from no other source, but their rights are subject to prior rights on the main river. These ditches are occasionally closed down to supply prior rights below.

The following table gives the decreed rights in district 9 and the prior rights in the lower districts:

Rights to water in district 9 and prior rights in lower districts.

Year.	Rights in district 9.		Prior rights in lower districts.	Year.	Rights in district 9.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1859	11.58	11.58		1868	17.21	281.14	469.71
1860	35.76	47.34		1869	7.94	289.08	581.22
1861	32.99	80.33		1870	1.49	290.57	634.61
1862	50.59	130.92	29.77	1871	28.42	318.99	682.19
1863	30.86	161.78	77.65	1874	12.00	330.99	1,793.07
1864	25.47	187.25	167.21	1878	26.68	357.67	2,708.96
1865	67.74	254.99	224.06	1881	4.01	361.68	3,375.19
1867	8.94	263.93	469.71	1882	75.87	437.55	3,821.40

The average flow of Bear Creek during the late summer, when there is likely to be a shortage of water on the main river, is considerably less than 100 cubic feet per second, and rights to this quantity in district 9 are prior to any rights on the main river below. Of the eighteen ditches in the district three received some water in each month of the season, and almost all of them received what was needed by the land under them during May, June, July, and August. The average daily diversion by all the ditches for the season of 1903 is reported as 94 cubic feet per second.

Eleven reservoirs in district 9 have decreed rights. These rights are based on the capacities of the inlet ditches, the sum of the rights being 212.98 cubic feet per second. This water can be diverted only outside of the irrigation season or when there is more water than is needed for direct irrigation. There are several other reservoirs, the rights of which have not been defined.

District 7.—District 7 includes the drainage area of Clear Creek and its tributaries. Clear Creek discharges into the South Platte at the boundary line between districts 8 and 2, and the water of Clear

Creek not used in district 7 can be used to supply rights in districts 2, 1, and 64. Rights in this district were decreed on the basis of the carrying capacities of the ditches.

The following table gives the volumes of water decreed to the ditches in district 7 and the prior rights in the districts below:

Rights to water in district 7, and prior rights in lower districts.

Year.	Rights in district 7.		Prior rights in lower districts.
	Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*
1860	76.43	76.43	----------
1861	139.11	215.54	----------
1862	40.15	255.69	29.77
1863	40.86	296.55	77.65
1864	50.94	347.49	167.21
1865	142.51	490.00	224.06
1866	2.80	492.80	469.71
1867	36.20	529.00	469.71
1868	23.14	552.14	469.71
1869	31.08	583.22	581.22
1871	34.94	618.16	682.19
1872	154.00	772.16	1,133.41
1873	118.23	890.39	1,250.59
1874	138.26	1,028.65	1,793.07
1877	18.26	1,046.91	2,584.25
1878	52.74	1,099.65	2,708.96
1881	32.34	1,131.99	3,375.19
1883	48.46	1,180.45	4,811.72
1889	33.60	1,214.05	6,238.22
1891	5.00	1,219.05	6,309.22
1893	15.00	1,234.05	6,337.22
1895	335.86	1.569.91	6,464.22

Six reservoirs have decreed rights, some rights being based on the capacities of inlet ditches and some on the capacities of the reservoirs. There has been a great deal of litigation between ditch owners in this district and those in district 2 in attempts to close down the ditches in district 7, to supply water to earlier ditches in district 2. This litigation has been continuous since 1888. The suits have usually taken the form of applications for injunctions, restraining the State officials from closing the head gates of the ditches in the upper district, and have usually been successful. Such an injunction was still in force in 1903. The district court in a suit brought in 1904 stated that the State officials had failed to close ditches with late rights in district 23, and until officials enforced the law in that district there was no justice in making other districts supply the water which should be supplied by district 23.

District 6.—District 6 comprises Boulder Creek and its tributaries, including Coal Creek. Boulder Creek is a tributary of St. Vrain Creek. A decree covering the rights of 69 ditches in this district was rendered in 1882. The volumes decreed to these ditches were based upon estimates of their capacities made by a civil engineer employed for that purpose. Each ditch was decreed a volume of water equal to its full capacity as estimated by the engineer.

The following table gives the rights in district 6 and the prior rights in districts 2, 1, and 64:

Rights to water in district 6 and prior rights in lower districts.

Year	Rights in district 6.		Prior rights in lower districts.	Year.	Rights in district 6.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1859	116.85	116.85	....	1872	221.23	2,550.47	1,133.41
1860	108.79	225.64	....	1873	378.17	2,928.64	1,250.59
1861	58.66	284.30	....	1875	195.29	3,123.93	1,979.57
1862	348.82	633 12	29.77	1876	81.00	3,204.93	2,352.21
1863	356.54	989.66	77.65	1878	94.56	3,299.49	2,708.96
1864	154.08	1,143.74	167.21	1879	60.60	3,360.09	2,732.59
1865	525.96	1,669.70	224.06	1881	113.46	4,373.55	3,375.19
1866	63.78	1,733.48	469.71	1882	2.00	4,375.55	3,821.40
1868	115.37	1,848.85	469.71	1885	83.30	3,558.85	5,081.72
1869	6.58	1,855.43	581.22	1889	3.00	3,561.85	6,238.22
1870	168.11	2,023.54	634.61	1893	2.28	3,564.13	6,337.22
1871	305.70	2,329.24	682.19				

In 1900 a decree defining the rights of ten reservoirs was handed down. The capacity of each of these is given, the total being 174,056,228 cubic feet per second, the dates running from 1869 to 1893.

Nine years after the adjudication certain ditches brought suit against other ditches in the district in an attempt to have their decrees cut down. It was alleged that the latter had never, up to the time of the decree, used any such amounts of water as were awarded them, but afterwards their capacities were enlarged and the area increased and the excess decreed put to use. The supreme court held that the decree was res adjudicata, nine years having elapsed. "One of the things determined and settled by the decree is the quantity of water to which the parties thereto are entitled."[a] No suits have been brought to close the ditches in this district for the benefit of those below. The early rights prior to any in the lower district are sufficient to absorb the ordinary flow of the stream.

District 5.—District 5 comprises the drainage area of St. Vrain Creek and its tributaries except Boulder and Coal creeks, which are in district 6. This district can receive water from no other source than St. Vrain Creek and its tributaries, and the water from St. Vrain can be used in districts 2, 1, and 64.

The decree defining rights in this district was rendered in 1882. In estimating the appropriations the referee found the areas actually irrigated by the ditches and the number of inches of water required. The duty of water, as estimated by the referee, varied from 1 cubic foot per second for 4 acres to 1 cubic foot per second for 48 acres. As a result of this method of computing rights many of the ditches were awarded more water than they could carry. The decree made the award in the terms of "customary inches." These inches were not defined, but they have since been reduced to cubic feet per second on the basis of the legal Colorado inch—38.4 inches equaling 1 cubic foot per second.

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[a] Boulder and Weld Ditch Co. *v.* Boulder Ditch Co., 22 Colo., 115.

The following table gives the amounts decreed and the sum of prior rights in lower districts:

Rights to water in district 5 and prior rights in lower districts.

Year.	Rights in district 5.		Prior rights in lower districts.	Year.	Rights in district 5.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
1860	47.31	47.31	----------	1872	163.63	2,263.90	1,133.41
1861	85.60	132.91	----------	1873	163.73	2,427.63	1,250.57
1862	158.14	291.05	29.77	1874	207.77	2,635.40	1,793.07
1863	167.90	458.95	77.65	1875	21.71	2,657.11	1,979.57
1864	119.46	578.41	167.21	1876	1.44	2,658.55	2,352.21
1865	227.08	805.49	224.06	1877	12.55	2,671.10	2,584.28
1866	126.23	931.72	469.71	1878	122.19	2,793.29	2,708.96
1867	34.31	966.03	469.71	1879	50.27	2,843.56	2,732.59
1868	12.79	978.82	469.71	1880	16.14	2,859.70	3,277.69
1869	48.89	1,027.71	581.22	1881	3.77	2,873.47	3,375.19
1870	815.52	1,843.23	634.61	1884	9.11	2,872.58	4,961.72
1871	257.04	2,100.27	682.19				

Nine reservoirs have decreed rights amounting to 346,755,061 cubic feet.

District 4.—District 4 comprises the drainage area of Big Thompson River and its tributaries. Water can be secured from no other stream, but the water of Big Thompson can be used in the lower end of district 2 and in districts 1 and 64. The decree for this district was rendered in 1883. Some of the rights are based upon the acreages said to be irrigated, as in district 5, while others are based upon the capacities of the ditches. In speaking of the capacities of the ditches in this district the referee said: "I find the capacity of the ditch by taking an average of the estimates."

The following table gives the rights in district 4 and the prior rights in the lower districts:

Rights to water in district 4 and prior rights in lower districts.

Year	Rights in district 4.		Prior rights in lower districts.	Year.	Rights in district 4.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1861	99.62	99.62	----------	1873	250.43	868.85	1,250.59
1863	37.14	136.76	77.65	1874	19.06	887.91	1,793.07
1864	42.73	179.49	167.21	1875	143.41	1,031.32	1,979.57
1865	139.92	319.41	224.06	1876	103.81	1,135.13	2,352.21
1866	74.45	393.86	469.71	1877	209.42	1,344.55	2,584.28
1867	97.03	490.89	581.22	1878	235.51	1,580.06	2,708.96
1868	3.77	494.66	581.22	1879	6.22	1,586.28	2,732.59
1869	31.51	526.17	581.22	1880	191.53	1,777.81	3,277.69
1870	39.04	565.21	634.61	1881	626.44	2,404.25	3,375.19
1871	40.00	605.21	682.19	1883	123.48	2,527.73	4,811.72
1872	13.21	618.42	1,133.41	1884	8.83	2,536.56	4,961.72

There are a large number of reservoirs in this district, six of which have decreed rights amounting to 680,478,665 cubic feet.

A suit was brought by the Lower Latham ditch in district 2 to have certain ditches in district 4, with later rights than its own, closed, and the water officials have been ordered to close these ditches when the supply is not sufficient to supply the Lower Latham ditch.

District 2.—District 2 includes the South Platte and its tributaries on the east side from the mouth of Cherry Creek to the mouth of the Cache la Poudre. It can receive water from districts 23 and 8 on the main river and from the streams in districts 9, 7, 6, 5, and 4 on the west side of the river. Rights in this district are subject to prior rights in districts 1 and 64. The decree was rendered in this district in 1883. Each ditch was decreed the amount of water which the referee found to be its full carrying capacity. The dimensions and grades of the various ditches were stated by the parties themselves, no engineer being employed, the capacities being computed from these estimates by the referee. Although no statements of the areas irrigated were made by the referee, he stated in his findings that "no more water was appropriated than is necessary for the irrigation of the lands under the ditch." The decree itself, however, does not contain this statement.

The following table gives the rights in district 2 and the prior rights in the lower ditches:

Rights to water in district 2 and prior rights in lower districts.

Year.	Rights in district 2.		Prior rights in lower districts.
	Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*
1860	29.77	29.77	
1862	47.88	77.65	
1863	89.56	167.21	
1864	56.85	224.06	
1865	245.65	469.71	
1866	111.51	581.22	
1869	38.39	619.61	
1870	47.58	667.19	15.00
1871	427.22	1,094.41	15.00
1872	12.18	1,106.59	39.00
1873	281.48	1,388.07	144.00
1874	159.50	1,547.57	405.00
1875	314.14	1,861.71	432.00
1876	205.07	2,066.78	490.50
1877	224.68	2,291.46	490.50
1878	23.63	2,315.09	490.50
1879	545.10	2,860.19	490.50
1881	281.21	3,141.40	615.00
1882	339.42	3,480.82	780.00
1885	350.00	3,830.82	1,580.90

Two reservoirs in this district have decreed rights, but the quantity of water to which they are entitled is not given in the decree. Ditch owners in this district have had considerable litigation in attempting to have water turned down to them from other districts. As was previously noted, suits against ditches in district 7 were unsuccessful, while one against ditches in district 4 was successful. Ditches in districts 8 and 9 are also closed at times. As shown by the preceding table, rights in district 2 are principally prior to rights in districts 1 and 64, so that it is seldom necessary to turn water down to these districts.

District 3.—District 3 comprises the drainage area of Cache la Poudre River and tributaries. Some water has been diverted into this district from tributaries of the North Platte and the Grand. Aside from this the district receives no water from outside its own limits. The water not used in district 3 can be used in districts 1 and 64. The decree which governs rights in this district was rendered in 1882. Rights were decreed on the basis of the capacities of the ditches, these capacities being computed from the dimensions of the ditches as testified to by their owners. The rights thus decreed were largely in excess of the quantities which had been used or which could be carried by the ditches; especially is this true of the rights of the small early ditches. The large ditches with late priorities received amounts approximating their actual capacities. Some of these rights have been attacked on the ground that the ditches could not carry the volumes of water decreed. In one such case the supreme court of the State held "if a mistake was made by the court in computing the capacity of the ditch, such a mistake can not be corrected in this proceeding; the capacity is res adjudicata as much as any other fact which the special statute requires the court to determine."[a] Under this decision the excessive rights are vested even if the ditches have never used the volume of water decreed and can not carry it. They can be lost only by abandonment.

The following table gives the rights in district 3 and the prior rights in lower districts:

Rights to water in district 3 and prior rights in lower districts.

Year.	Rights in district 3.		Prior rights in lower districts.	Year.	Rights in district 3.		Prior rights in lower districts.
	Rights acquired.	Sum to date.			Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*		*Cubic feet per second*	*Cubic feet per second.*	*Cubic feet per second.*
1860	24.80	24.80		1872	317.95	1,794.36	39.00
1861	24.08	48.88		1873	440.86	2,235.22	144.00
1862	127.20	176.08		1874	229.87	2,465.09	405.00
1863	8.70	184.78		1875	88.52	2,553.61	432.00
1864	78.40	263.18		1876	13.44	2,567.05	490.50
1865	39.63	302.81		1877	126.85	2,693.90	490.50
1866	82.47	385.28		1878	611.06	3,304.96	490.50
1867	169.51	554.79		1879	287.11	3,502.97	490.50
1868	55.30	610.09		1880	173.67	3,765.74	517.50
1869	65.92	676.01		1881	532.42	4,298.16	615.00
1870	191.25	867.26	15.00	1882	33.97	4,332.13	780.00
1871	609.15	1,476.41	15.00	1884	315.00	4,647.13	1,580.90

There is a large number of reservoirs in this district, but their rights had not been defined in 1904. Testimony regarding the capacities and dates of construction of these reservoirs was taken during the summer of 1904 preparatory to an adjudication. The rights in this district, which are prior to any in the lower districts, are sufficient to use the entire flow of the river during seasons of low water when shortage would occur in the lower districts.

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[a] Water Supply and Storage Company *v.* Larimer and Weld Company, 24 Colo., 323.

District 1.—District 1 comprises the lands watered by the South Platte and its tributaries between the mouth of Cache la Poudre and the west line of Washington County. The district can receive water from all the districts above on the main stream and the tributaries and is obliged to supply water to district 64 below. The rights in this district are in general later than those in the districts above, so that it can demand little water from them. The decree defining the rights in this district was rendered in 1895. The standard by which the rights were measured was the amount of water actually used. The referee found that each ditch, with four exceptions, had used water to its full capacity. The four ditches excepted were held not to have used water to their full capacities, and were decreed less than these amounts.

The following table gives the rights in district 1 and the prior rights in lower districts:

Rights to water in district 1 and prior rights in the lower district.

Year.	Rights in district 1.		Prior rights in lower district.
	Rights acquired.	Sum to date.	
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*
1869	15.00	15.00	
1871	24.00	39.00	
1872	15.00	54.00	
1873	8.00	62.00	90.00
1874	25.00	87.00	343.00
1875	21.00	108.00	345.00
1876	27.00	135.00	382.50
1880	10.00	145.00	382.50
1881	165.00	310.00	470.00
1882	461.00	771.00	470.00
1884	60.00	831.00	809.90
1886	99.00	930.00	869.90
1887	20.00	950.00	932.40
1888	625.00	1,575.00	932.40
1889	71.00	1,646.00	932.40

Six reservoirs in this district supplied from torrential tributaries of the South Platte have decreed rights. There are a few reservoirs, built since the decree was rendered or now under construction, rights for which are undefined. Some of the large ditches in this district have rights later than those in district 64, and are closed by the water commissioner on order of the division engineer when water is scarce.

District 64.—District 64 comprises all the lands watered by the South Platte River and its tributaries between the western boundary of Washington County and the Colorado-Nebraska State line. Five adjudications of water rights have taken place in this district. In the first adjudication, in 1894, the court found that 1 cubic foot of water per second is needed for the irrigation of every 50 acres of land, and that in addition there is lost by seepage and evaporation 25 per cent of the volume used. The decree awards water to the ditches according to this rule. The second adjudication took place in 1896. Three ditches were awarded amounts equaling their claimed capacities. The last three decrees in district 64 were rendered in 1897, 1898, and 1903. Several ditch owners whose rights were not included in any of these decrees have petitioned for a hearing and a determination of their rights. In these adjudications each ditch was awarded 1 cubic foot per second for every 50 acres found to be irrigated by it, with no additional allowance for seepage or evaporation. This district, being the lowest on the river in Colorado, can receive water from all the districts above, and so far has not been required to turn water down to ditches in Nebraska.

The following table shows the rights decreed in this district:

Rights to water in district 64.

Year.	Rights in district 64.		Year.	Rights in district 64.	
	Rights acquired.	Sum to date.		Rights acquired.	Sum to date.
	Cubic feet per second.	*Cubic feet per second.*		*Cubic feet per second.*	*Cubic feet per second.*
1872	90.00	90.00	1890	3.00	935.40
1873	253.00	343.00	1892	25.00	960.40
1874	2.00	345.00	1893	85.00	1,045.40
1875	37.50	382.50	1894	42.00	1,087.40
1880	87.50	470.00	1895	490.00	1,577.40
1882	189.90	659.90	1896	50.00	1,627.40
1883	150.00	809.90	1897	50.00	1,677.40
1884	60.00	869.90	1898	60.00	1,737.40
1886	62.50	932.40			

There are in this district several large ditches recently built which have no decreed rights, but proceedings for defining their rights were begun in 1904. It is reported that plans for the construction of at least one large reservoir have been completed.

NEBRASKA.

The South Platte River in Nebraska is in Division 1-A. The rights along this section of the stream have not been finally decided by the State board of irrigation or by the courts. An adjudication was held at which rights to irrigate 5,200 acres, dated 1894, were conditionally granted, and rights to irrigate 2,040 acres, dated 1895, were also conditionally granted. The supreme court has recently held that the board of control had no power to place conditions on rights initiated prior to the enactment of the law of 1895. Under this decision these rights, as determined by the board, are vested, and can be lost only by abandonment, which requires ten years' nonuse.[a] On the basis of the maximum volume of water allowed in Nebraska—1 cubic foot per second for 70 acres—this gives rights to 82.86 cubic feet per second, dated 1894, and 29.14 cubic feet per second, dated

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[a] Farmers' Irrig. Dist. *v.* Frank, 100 N. W., 286.

1895. In addition to these, applications have been approved by the board as follows:

Applications approved for the diversion of water from the South Platte River in Nebraska.

Date.	Area.	Volume.
	Acres.	*Cubic feet per second.*
1895	1,400	20.00
1896	11,895	169.93
1897	15,540	222.00
1898	440	6.29
Total	29,275	418.22

Final proof has not yet been made on the rights for which the above permits were issued; hence it can not be stated what rights actually exist here.

These are the only rights on the South Platte in Nebraska acquired by appropriation. Under the doctrine announced in Crawford Company *v.* Hathaway (see p. 85), riparian lands in the State acquired from the Government prior to 1889 have rights to a reasonable use of water for irrigation dating from the time of their acquirement from the Government. The lands along the stream, with the exception of very small tracts, were acquired from the Government before 1894, the date of the earliest right in Nebraska acquired by appropriation. The date of the first acquirement of any lands from the Government in the vicinity of the junction of the North and South Platte rivers was 1871. The railroad lands between the junction of the rivers and the west line of range 32 west, in the neighborhood of the town of Hershey, were selected in 1874. West of that private lands were acquired from the Government mostly after 1883, while the railroad lands in the four townships next west were selected in 1890 after the passage of the irrigation law which the Nebraska court has held abrogated riparian rights, and therefore have no such rights. Private lands in this section were mostly taken up later than 1883. The railroad lands in ranges 37, 38, 39, 40, and 41 were selected in 1886. Private lands in these ranges were taken after 1883. In range 42, immediately below the Colorado-Nebraska line, railroad lands were selected in 1892, and therefore have no riparian rights. Private lands in this section were acquired between 1883 and the present time.

Under the decision in Crawford Company *v.* Hathaway it is held that riparian rights extend only to the land acquired from the Government under a single patent, and that in case of railroad lands it does not extend to the entire section, but only to the subdivisions usually disposed of by the Government. The South Platte River is a meandered stream, and most of the riparian lands were disposed of in lots rather than in even fractions of a section. As a rule, therefore, riparian rights extend to small areas only. The right of the riparian owner is to a reasonable use of water for irrigation, taking into consideration a like reasonable use by all other riparian owners. It is therefore impossible to make any statement of the volume of water to which these riparian lands are entitled. Under the common-law doctrine the right of a riparian proprietor certainly goes no further than to have the stream continue to flow "as it was wont to flow." The flow of the stream in this section from the earliest exploration of this region has been extremely uncertain, the stream going dry in many years and being extremely low in parts of almost every year. (See p. 46.) It is therefore very doubtful whether these riparian proprietors could secure any damages due to shortage of water, since the ditch owners could probably prove that during the season when there is a scarcity of water the river was wont to run dry.

The following table brings together all the decreed rights to water from South Platte River and tributaries, by years:

Rights to water from South Platte River and tributaries.

Year.	Colorado.		Nebraska.		Total.
	Rights acquired.	Sum to date.	Rights acquired.	Sum to date.	Sum to date.
	Cubic feet per sec.	*Cubic feet per sec.*	*Cubic feet per sec.*	*Cubic feet per sec.*	*Cubic feet per sec.*
1859	128.43	128.43			128.43
1860	389.86	518.29			518.29
1861	533.85	1,052.14			1,052.14
1862	755.28	1,807.42			1,807.42
1863	765.46	2,572.88			2,572.88
1864	605.94	3,178.82			3,178.82
1865	1,422.79	4,601.61			4,601.61
1866	514.70	5,116.31			5,116.31
1867	481.82	5,598.13			5,598.13
1868	285.90	5,884.03			5,884.03
1869	245.31	6,129.34			6,129.34
1870	1,190.99	7,320.33			7,320.33
1871	1,736.47	9,056.80			9,056.80
1872	999.90	10,056.70			10,056.70
1873	2,031.83	12,088.53			12,088.53
1874	937.96	13,026.49			13,026.49
1875	1,048.68	14,075.17			14,075.17
1876	731.47	14,806.64			14,806.64
1877	698.65	15,505.29			15,505.29
1878	1,619.09	17,124.38			17,124.38
1879	2,493.66	19,681.04			19,681.04
1880	629.19	20,247.23			20,247.23
1881	2,171.40	22,418.63			22,418.63
1882	1,591.72	24,010.35			24,010.35
1883	377.21	24,387.56			24,387.56
1884	693.65	25,081.21			25,081.21
1885	619.78	25,700.99			25,700.99
1886	318.71	26,019.70			26,019.70
1887	183.87	26,203.57			26,203.57
1888	1,304.29	27,507.86			27,507.86
1889	126.60	27,633.46			27,633.46
1890	33.00	27,666.46			27,666.46
1891	35.00	27,701.46			27,701.46
1892	25.00	27,726.46			27,726.46
1893	102.28	27,828.74			27,828.74
1894	42.00	27,870.74	82.86	82.86	27,953.60
1895	825.86	28,696.60	49.14	132.00	28,801.39
1896	50.00	28,746.60	169.93	301.93	29,933.32
1897	50.00	28,796.60	222.00	523.93	30,007.25
1898	60.00	28,856.60	6.29	530.22	30,597.47

As shown by the tables given, there is a stream discharge of 2,765 cubic feet per second, and established rights to this supply amounting to 30,597.47 cubic feet per second, or more than ten times the total supply as measured above the heads of the ditches.

QUESTIONS BETWEEN THE STATES.

Comparing the rights in Colorado and Nebraska on the supposition that the State line has no effect upon the rights to water, but that all rights on the stream are subject to prior rights, we find the following conditions:

The earliest rights on the South Platte in Nebraska are the riparian rights attached to the lands in the vicinity of the junction of the North and South Platte rivers, acquired from the Government in 1871. Under the decisions of the Colorado courts, rights to 7,320.33 cubic feet per second were acquired prior to 1871. Alternate sections of the land in this vicinity were granted to the Union Pacific Railroad Company. These were selected in 1874, prior to which date there had been acquired in Colorado rights to 12,088.53 cubic feet per second. Settlement as early as 1871 extended only a short distance west of North Platte. Beyond this, as far as the Colorado line, riparian lands acquired from the Government by private parties were entered from 1883 up to the present time. Prior to 1883 rights to 24,010.35 cubic feet per second had been acquired in Colorado. The railroad lands from the vicinity of the town of Hershey to the town of Korty were selected in 1890 and have no riparian rights. From the town of Korty west almost to the State line railroad lands were selected in 1886. Prior to their selection rights to 25,700.99 cubic feet per second had been acquired in Colorado. The earliest right to water from the South Platte in Nebraska acquired by appropriation is 1894. Prior to this, rights to 27,828.74 cubic feet per second from the South Platte and tributaries had been acquired in Colorado.

From the above statement it is seen that before any rights were acquired in Nebraska, either by appropriation or by the purchase of riparian lands from the Government, rights to more than 7,300 cubic feet per second of water from the South Platte River and its tributaries had been acquired in Colorado. This is more water than the stream supplies, except in flood season, when there is plenty of water in the river, both in Colorado and Nebraska, for all existing rights. However, it is a well-known fact that a large part of the rights decreed to ditches built earlier than 1870 in Colorado are in excess of their carrying capacities, and this does not fairly represent the volume which can be used by canals on their priorities earlier than 1870.

The largest appropriations in the South Platte Valley in Colorado were made in the years from 1870 to 1882. All of the rights attaching to these ditches are prior to the acquirement of riparian lands either by private parties or the Union Pacific Railroad, except in the immediate vicinity of North Platte. The general conclusion as to rights on the South Platte must therefore be that both under the doctrine of prior appropriation and under the doctrine of riparian rights, as stated by the supreme court of Nebraska, Colorado ditch owners have the earlier rights.

As to the relation of rights acquired by appropriation in Colorado to riparian rights in Nebraska, even if the supreme court of Nebraska had not held that lands acquired from the Government since 1889 had no riparian rights and that as between riparian rights and those acquired by appropriation the date of acquirement should govern, rights by appropriation in Colorado would probably be held to be superior to riparian rights of lands acquired from the Government since the acquirement of the rights in Colorado. The law of Congress of 1866 provides "that whenever by priority of possession rights to the use of water for mining, agricultural, manufacturing, or other purposes have vested and accrued and the same are recognized and acknowledged by the local customs, laws, and decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same." The rights in Colorado were acquired in accordance with local customs and laws, and would seem to be good as against the rights attached to lands acquired subsequently, whether these lands are in a State where the same customs and laws are enforced or outside of it.

Although there are sufficient rights in Colorado prior to any in Nebraska to exhaust the ordinary flow of the South Platte, there is sufficient return seepage from the river to provide, in some seasons of the year, a considerable flow in the vicinity of the State line (see p. 48). In district 64 in Colorado, which is immediately above the State line, several ditches have been constructed recently and are constantly enlarging their use of the water as more land is reclaimed. The rights of some of these ditches are subsequent to both riparian rights and those acquired by appropriation in Nebraska, and controversy may arise between the owners of the ditches in district 64 and those in Nebraska.

It has been shown in the preceding pages that the rights decreed in Colorado are in many cases largely in excess of the quantities which have been used by the ditches. Mr. Adams estimates the amount decreed to the 109 ditches for which he kept records, in excess of their carrying capacities, at 4,164 cubic feet per second, or more than 30 per cent of the total amount decreed them. These were, however, the larger ditches. The smaller ditches received decrees even more in excess of their capacities. This estimate is based on the capacities of the ditches, not on the volume of water which has been put to a beneficial use. The excess is, therefore, larger than that given. However, only a few of the large ditches in Colorado have rights to more water than they can carry, or more than is used under them when it can be secured, and few of them receive their full decreed amount during times of low water. The rights of most of the large ditches are prior to any rights acquired by appropriation in Nebraska. Therefore, the cutting down of the rights of the Colorado ditches to the amounts actually used by them would be of no benefit to Nebraska ditches, since the water taken from the early ditches would go to supply ditches in Colorado, which, although later than the ditches which would be cut down, are still prior to the ditches in Nebraska.

What is true as to excessive rights in Colorado is equally true as to rights in Nebraska. The State board of irrigation of Nebraska held an adjudication on the South Platte and allowed rights to large areas which were not yet irrigated, on condition that the canals be constructed and the water applied to the land. In the case of The Farmers' Irrigation District *v.* Frank[a] the supreme court of Nebraska held that in a similar case on the North Platte the State board of irrigation had no authority to grant rights, but was limited to defining rights as they existed at the time of the adjudication; that therefore the conditions prescribed by the board would not hold and the ditch owners had absolute rights to the volumes allotted to them by the board, which rights could be lost only by abandonment, which required ten years' nonuse. Under this decision the situation in Nebraska is even worse than that in Colorado. In Colorado there was at least a claim that the water had been used or that ditches had been built, while in Nebraska no such claim was made, but the use was almost entirely prospective. Had the board known that it was not empowered to fix these conditions probably it would have defined the rights on the basis of what had been used rather than on the prospective use, but the decision of the supreme court puts on the decree of the board a meaning which was never intended and which contains no element of justice to other appropriators from the stream. The court states that the board could not grant a right, while the effect of the decisions is that the board did grant a right. We have, then, in the two States conditions as to excessive rights differing only in degree. In Colorado the courts in determining rights decreed to many of the ditches more water than they had ever used or could carry. These decrees not being appealed from within the statutory period, the rights are held to be vested and can be lost only by abandonment. Other ditches have used the water belonging to the first ditches under these decrees, but not used by them; but the first ditches have been enlarged to use their surplus, or the excess over their need or capacities has been sold, thereby taking water away from those who had been using it perhaps for years. The excessive rights are therefore a menace to all later rights. In Nebraska the board conditionally allowed rights for lands yet to be reclaimed, and the supreme court has removed the conditions, so that the rights have vested without the performance of the conditions and can be lost only by abandonment. This leaves all later rights liable to suffer from enlarged use under these excessive rights, and hence discourages development by making the title to the water uncertain pending the expiration of the statutory period for the loss of the excessive rights by abandonment. Fortunately this applies only to rights initiated before 1895 and adjudicated by the State board of irrigation. As these adjudications were held nearly ten years ago and little has been done toward putting to use the water allotted, the time will soon come when these rights can be declared abandoned if proper actions are brought.

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[a] 100 N. W., 286.

The excessive rights in both States are a menace to all later rights in either State, but it seems that decrees of each State allowing them must be recognized by the other State until the rights are lost by abandonment.[a]

EFFECT OF PHYSICAL CONDITIONS.

So far the rights to South Platte River have been discussed as if there was a fixed supply of water, which, if not taken by one ditch, would remain in the stream to be taken by others, and which, if taken by one ditch, was entirely consumed and not available for others. This, however, is not the case. If it were true, only a few of the earliest ditches could be supplied by the Platte River and its tributaries.

To illustrate this: During the latter part of August, 1903, measurements of the flow of the stream and the diversions in district 8 were made. The flow where the river enters this district was 91.85 cubic feet per second. The flow at Denver, where the river leaves the district, was 46.36 cubic feet per second, while the diversion between the two points amounted to 134.53 cubic feet per second, showing that there was diverted almost 50 per cent more water than was flowing past the gauging station, while there remained in the stream at the lower end of the district half as much water as there was entering at the head of the district.

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[a] A judgment of a court of a sister State, authenticated as prescribed by act of Congress, is conclusive here upon the subject-matter of the suit. An action thereon can only be defeated on the ground that the court had no jurisdiction of the case and there was fraud in procuring the judgment, or by defenses based on matters arising after the judgment was rendered. (Snyder *v.* Critchfield, 44 Nebr., 66.)

Distributing water in accordance with the rights is not, therefore, a simple division of a fixed quantity of water, in accordance with a definite table of priorities. In order that rights to a certain volume in the lower districts be supplied it is not always necessary to allow this volume to flow down from the upper districts, but it may be supplied to the stream by seepage. Again, there are sections of the river where water, if turned down for lower ditches, would be lost by sinking in the sand or by evaporation, so that it could not reach the heads of the lower ditches. So long as a water-right holder secures his proper supply of water it is a matter of indifference to him what is done above him on the stream. Physical conditions, therefore, have a great deal to do with the relations of rights.

The right of the riparian proprietor is not to enough water to irrigate his riparian land, but to a reasonable use of what water flowed naturally to his land. This raises the question as to what water naturally flowed in the South Platte River at the time these riparian lands were acquired, and as to what influence irrigation above has had on any changes which may have taken place in the flow of the stream since that time. To determine this, in the absence of the records of the flow of the stream in early years, it has been necessary to collect the testimony of settlers and travelers as to early conditions and to make measurements to determine the present effect of diversions on the upper sections of the stream upon the flow of the stream in the lower section. Such measurements have been carried on for a number of years by the Colorado Agricultural College and Experiment Station, and by the State engineer's office of Colorado, and during the season of 1903 a series of similar measurements was made by Mr. C. E. Tait, of this Office, and Prof. O. V. P. Stout, of the University of Nebraska. The testimony as to the early conditions on the river and the measurements of return seepage are brought together in the following pages.

The published reports of early travels and explorations along the South Platte River give little definite information as to its flow.

Long's expedition crossed the South Platte June 20, 1820. He described the Platte River as follows: "It is about 9,000 yards wide and very rapid, but so shoal that we found it unnecessary to dismount from our horses or unpack our mules."[a] As this was in June, the river should have been in flood.

Thomas J. Farnham in his Travels in the Great Western Prairies, etc., London, 1843, speaking of the Platte, says: "This river is not navigable for steamboats at any season of the year. In the spring floods the bateaux of the American fur traders descend it from the forts on its forks. But even this is so hazardous that they are beginning to take down their furs in wagons. * * * During the summer and autumn months the waters are too shoal to float a canoe." (Page 106.)

Fremont's expedition went up the South Platte in July, 1842. He states that the stream was not navigable for anything drawing 6 inches of water.

Edwin Bryant, in What I Saw in California,[b] states that he met a fur trader who had started down the Platte with furs and was obliged to leave his boats on account of the low water June 11, 1849.

Stansbury's expedition crossed the South Platte a short distance above North Platte June 28, 1849. He states that the river was easily crossed in low water. (Page 272.)

None of these early explorers speak of the river as being dry, yet all seem to agree that it got very low, in the summer at least. As Fremont says: "It is not navigable for anything drawing 6 inches of water."

There are yet living in the basin of the Platte a great many people who went to that section before irrigation began. Statements as to the condition of the river have been secured from a number of those early settlers.

W. R. Bryant, of Cheyenne, Wyo., says that he "was along the Platte River in Nebraska and Colorado during the sixties in every year until 1870. He never saw the Platte dry but once; that was in the fall of 1864, for a distance of about 75 miles below the Colorado line. In that season water could be found anywhere in the bed of the Platte by digging 2 or 3 feet into the sand."

H. B. Kelley, of Cheyenne, Wyo., said that the Platte occasionally ran dry in the neighborhood of Julesburg. He remembered one or two occasions when it was so, but could not give the dates. He is of the opinion that in both branches of the Platte there was more water in the early days than now, and suggested as a possible reason for this the removal of the timber on the headwaters.

Maj. John Talbot, of Cheyenne, Wyo., stated that he came to Fort Laramie, Wyo., in 1854; he said that the South Platte never ran dry above the forks until about 1875, and once about 1864 or 1865 it ran dry at Fort Kearney.

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[a] Long's First Expedition, vol. 1, p. 467. Philadelphia, 1823.

[b] D. Appleton & Co., New York, 1849, p. 83.

John J. Brewer, of Irondale, Colo., stated that he came to Colorado in 1861. He said that he remembers well hearing the freighters who came along the South Platte say that down toward the Colorado line the river sank into the sand and they were obliged to dig holes to water their horses. He was of the opinion that this was in the years before 1870.

John Lillie, of Littleton, Colo., stated that the South Platte was dry in 1863 from a point 10 miles below Denver for 200 or 300 miles anyway, and he did not know how much farther. In some seasons there used to be some water in the South Platte in the neighborhood of the State line, and in other seasons it ran dry and disappeared in the sand for long stages.

Judge Ames, of Littleton, Colo., says that he came to Colorado in 1860. The season of 1863 was unusually dry. Water flowed down the river only a short distance below Denver. He remembered that in that year in particular the freighters told of having to dig holes in the sand in order to get water for animals.

Ed. Montgomery, of Littleton, Colo., says that he came West in 1860. In the summers of 1862-1864 he was freighting along the river and found plenty of water. However, in 1863 the river went dry and it was necessary to dig holes to secure water.

C. C. Hawley, of Fort Collins, Colo., says that he came West in 1860. He went along the South Platte River in the summer of 1863 and from a short distance below the mouth of the Poudre all the way down beyond to the State line the river was entirely dry and they were obliged to dig for water. He went down the South Platte to Julesburg late in the summer of 1864 in connection with the Indian troubles, as he was in the Army. The river was then completely dry, as before, there being only now and then a hole with a little water in it.

Mr. Hawley understands from the oldtimers that, as a usual thing, the South Platte went dry every summer from below the mouth of the Poudre for a distance of 200 miles, very nearly to the junction of the North and South forks.

Bruce Johnson, of Greeley, Colo., came out in 1859. He went up and down the South Platte two different years during the sixties, but did not remember which years. Both of these years the river was dry from Julesburg to the junction, and in one of these years—he thought it was in 1864—the river was dry from the junction to Fort Kearney, and farther down for all he knew. The river in the years mentioned was completely dry.

Hon. Eugene F. Ware, formerly Commissioner of Pensions, Topeka, Kans., who was with the United States troops along the Platte River in the sixties, stated that in 1865 he saw the buffalo pawing in the bed of the Platte to obtain water.

J. J. Armstrong, of Denver, Colo., says that he came to Colorado in 1870. That in the early days, from Platteville down, the South Platte River was practically dry in August and September, except for a few small channels. In 1873 he rode from near Platteville or Greeley along the bed of the river, which was nothing but sand bars with a few small, trickling channels.

Mr. Ryan, conductor on the Burlington Railroad between Nebraska City and Lincoln, Nebr., was freighting along the Platte River from 1860 to 1865. He stated that in 1863 the river was dry west of Julesburg for 100 miles.

John Bratt, of North Platte, Nebr., says that he thinks the South Platte went dry in the sixties, the same as it does now. In the early seventies he bought land along the South Platte; since that time the river has usually gone dry at times in summer, usually in August, but in the early summer there was more water then than now.

Charles McDonald, of North Platte, Nebr., was along the South Platte in the sixties. He says that the river went dry in 1862, and also in 1871.

Hon. John Evans, of North Platte, Nebr., says that he has been living in North Platte since 1871; that in early times the river went dry in exceptional years. Since 1895 it has gone dry every year.

W. A. Paxton, of Omaha, Nebr., who has had cattle ranches on the Platte since the early sixties, states that the river went dry in 1863, 1866, and 1871, and that it has gone dry every year since about 1885 or 1886.

Henry T. Clarke, of Omaha, Nebr., built several bridges across the Platte River in 1874. He states that in that year the river was dry, and it was necessary to dig holes in the river bed to secure water for his cattle.

Summing up these statements, the accounts of the early travelers and explorers, while not stating that the river was dry, all agree as to its being very low in summer. The testimony of the parties living in the Platte Valley show that the river was dry in places, and for short periods at least, during the years 1863, 1864, 1865, 1866, 1871, 1873, 1874, and 1875. For these years we have definite statements. For the years 1863 and 1864 we have a large number of statements that the river was dry. In addition to these definite statements as to particular years, we have the statement of J. J. Armstrong that it usually went practically dry; the statement of John Brewer that he heard freighters say that the water sank into the sand and that they were obliged to dig for water. Mr. Hawley states that he understood from the talk of oldtimers that as a usual thing the South Platte went dry below the mouth of the Cache la Poudre nearly to the junction of the North and South Platte rivers. Mr. John Bratt, of North Platte, states that it was his opinion that it went dry in the sixties as now. It seems, from these statements, that there can be no question that from the time of the earliest travelers the river has gone dry during the summer, in some years at least, and that it has always been very low in the late summer, and that in the summers of 1862 to 1866, before there were enough diversions in Colorado to have any effect upon the flow of the stream, the river went dry. In the early seventies, before the construction of most of the large canals in Colorado, there was another series of years when the river was dry. Since the building of the large canals in Colorado and the irrigation of large areas of land—that is, since 1885 and 1886—the river is said to have gone dry practically every year.

The fact that there never have been and are not now any irrigating ditches of any considerable size along the section of the river immediately above the State line and between that point and the junction of the branches of the Platte would also point to the conclusion that there never has been any reliable supply of water in this section of the South Platte River.

As has been stated before, the ownership of riparian land gives its owner no more than a right to have the river continue to flow as it was wont to flow. The above testimony shows conclusively that in the section of the river from the State line to the junction there never has been a reliable flow; that the river has gone dry in many years and has been extremely low every year. Under the doctrine announced by the Nebraska supreme court in Crawford *v.* Hathaway the riparian proprietor is not entitled to enjoin diversions for irrigation, but merely to damages resulting from the diversion of water by later appropriators. With the records showing that the river went dry in many years before irrigation began, it will be practically impossible for a riparian proprietor along this section of the river to prove that any damage which he may suffer from shortage of water is due to the diversion of the water above.

RETURN SEEPAGE.

It is contended by many people in Colorado and by some in Nebraska that irrigation on the stream in Colorado not only has not decreased the supply in Nebraska except during the spring flood, but has actually improved the condition of the river, or will do so in the future. The seepage measurements which are given below seem to show that an increase in the flow in the late summer is gradually progressing downstream and has already reached the State line.

Measurements have been made in the fall of every year since 1889, with the exception of 1897, to determine the amount of water returning to the river in the form of seepage. The results of these measurements, with the exception of those made in 1903, as brought together in the following table, are taken from the reports of State engineers of Colorado. The measurements in 1903 were made by Mr. C. E. Tait, of this Office. (See map, Pl. I.)

Gain in flow of South Platte River from return seepage.

Section.	Distance.	1889.	1890.	1891.	1892.	1893.	1894.	1895.
	Miles.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec*
Platte Canyon to head of City ditch	5.25	--------	--------	27.57	25.32	18.41	49.23	20.21
Head of City ditch to Littleton	6.25	49.91	11.73	52.61	44.63	23.50	25.59	55.23
Littleton to Denver	10.50	1.00	43.88	16.20	59.61	41.27	118.92	117.80
Denver to Brighton	21.25	26.16	43.30	78.81	−13.39	69.73	84.30	13.89
Brighton to Platteville	16.00	56.31	78.00	51.74	64.37	65.91	65.01	134.44
Platteville to Evans	17.00	63.62		72.28	12.32	61.11	107.46	44.28
Evans to Putnam ditch	27.50	188.58	156.69	119.50	137.75	85.85	98.61	179.41
Putnam ditch to Fort Morgan	27.50		50.58	51.80	--------	113.89	158.52	234.11
Fort Morgan to Snyder	11.50							14.82
Snyder to Merino	18.00		21.53	79.73	--------	34.72	58.67	145.26
Merino to Sterling	14.50	32.75	29.45	33.36	--------	33.76	43.80	46.80
Sterling to Iliff	10.00	4.44	14.05	28.07	--------	24.84		16.99
Iliff to Crook	15.00	--------	--------	−13.07	--------	--------		−48.05
Crook to Sedgwick	17.00	--------	--------	3.31	--------	--------	−34.17	−32.89
Sedgwick to State line	15.50	--------	--------					
Total	232.75	422.77	449.21	602.00	330.61	572.99	722.56	942.30

Section.	Distance.	1896.	1898.	1899.	1900.	1901.	1902.	1903.
	Miles.	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*	*Cu. ft. per sec.*
Platte Canyon to head of City ditch	5.25	10.18	1.21	72.93	33.96	21.22	5.04	31.64
Head of City ditch to Littleton	6.25	14.76	26.44	60.96	40.17	11.49	13.24	24.31
Littleton to Denver	10.50	33.95	61.63	16.40	16.22	35.63	24.90	12.56
Denver to Brighton	21.25	67.29	49.66	124.01	70.27	73.29	48.67	103.60
Brighton to Platteville	16.00	92.87	112.35	88.79	56.08	130.67	66.24	44.42
Platteville to Evans	17.00	37.59	110.97	111.50	117.10	138.84	95.17	85.56
Evans to Putnam ditch	27.50	87.99	160.13	150.38	79.14	182.24	92.23	139.77
Putnam ditch to Fort Morgan	27.50	90.61	94.62	97.74	99.79	90.89	117.28	85.27
Fort Morgan to Snyder	11.50	52.79	37.13	72.63	83.77	65.87	61.33	46.24
Snyder to Merino	18.00	66.21	--------	93.87	85.54	97.04	80.35	34.76
Merino to Sterling	14.50	32.60	--------	73.73	62.03	47.00	97.17	73.92
Sterling to Iliff	10.00	21.36	--------	46.19	5.19	32.04	7.27	39.27
Iliff to Crook	15.00	--------	--------	69.38	23.64	12.12	29.83	4.61
Crook to Sedgwick	17.00	--------	--------	−17.13	−50.69	3.73	.10	1.71
Sedgwick to State line	15.50	--------	--------	41.23	77.98		10.67	1.97
Total	232.75	608.20	654.14	1,102.61	800.19	941.57	749.49	729.61

In 1903 measurements were carried on down the river in Nebraska so far as there was any visible flow in the stream. These measurements were made by Prof. O. V. P. Stout, of the University of Nebraska. The first section measured extended from the head of the Western Canal to Ogallala, 26.5 miles, and showed a loss of 74.86 cubic feet per second. The second section extended from Ogallala to Korty, a distance of 13 miles, and showed a loss of 7.71 cubic feet per second, making a total loss between the head of the Western Canal, which is very near the State line, and Korty, where the river was dry, of 82.57 cubic feet per second, or all the water in the stream.

The table given above shows that there is no uniformity in the gain in any section from year to year or in the stream as a whole. The amount of return seepage depends on so many factors which vary from year to year that it is not to be expected that there would be any uniformity or any gradual increase or decrease in the seepage returns in any given section. The amount of water coming into the stream from the lands bordering it in any section must depend primarily upon the amount of water received by these lands, either in the form of rainfall or irrigation. The amount of rainfall varies from year to year without any fixed law, and the amount used in irrigation depends upon the amount which can be secured for that purpose. In general, then, larger returns will be expected in wet years than in dry years, since in such years the lands receive more water from both irrigation and rainfall.

The rate of flow of water through soils is extremely slow, and water applied to land at some distance from the stream takes several years to reach the stream, so that the entire effect of heavy irrigation may not be shown immediately in the return seepage. This would tend to decrease the variations in the return flow due to wet and dry seasons. It is therefore practically impossible to establish any relation between the quantity of water received by land and the amount of water which will be supplied by this land to the stream.

The measurements given in the table for each year were made by a party which started at the canyon and went down the stream, the supposition being that the rate of progress made by the party would be about the same as the velocity of the flow of the river. In this way any changes would be attributed to losses or gains in the channel of the stream rather than to the rising and falling of the stream as a whole. It is impossible to eliminate entirely the effects of increases and decreases in the flow of the stream as a whole, and to the extent to which such fluctuations occur the value of these measurements, as indexes of return seepage, is destroyed. Grouping these measurements into periods will help to minimize the effect of variations since these will tend to offset each other. The measurements given cover fourteen years. Dividing these into two seven-year periods gives the results which are shown in the following table:

Gain or loss in flow of South Platte River by seven-year periods.

Section.	Length.	Before 1896.		After 1895.	
		Total.	Per mile.	Total.	Per mile.
	Miles.	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*	*Sec.-feet.*
Platte Canyon to City ditch	5.25	28.15	5.36	25.17	4.79
City Ditch to Littleton	6.25	37.17	5.95	27.34	4.36
Littleton to Denver	10.50	56.95	5.42	28.76	2.74
Denver to Brighton	21.25	43.26	2.04	76.68	3.61
Brighton to Platteville	16.00	67.94	4.25	84.49	5.28
Platteville to Evans	17.00	57.32	3.37	99.53	5.85
Evans to Putnam ditch	27.50	119.90	4.36	127.41	4.63
Putnam Ditch to Fort Morgan	27.50	93.34	3.39	95.17	3.46
Fort Morgan to Snyder	11.50	25.12	2.18	59.97	5.21
Snyder to Merino	18.00	63.35	3.52	76.30	4.24
Merino to Sterling	14.50	32.03	2.21	64.41	4.44
Sterling to Iliff	10.00	16.58	1.66	25.22	2.52
Iliff to Crook	15.00	−14.83	−.99	27.92	1.86
Crook to State line	32.50	−21.25	−.65	13.91	.43

In some years the sections between measurements were not the same as those given in the table, but included two or more of the sections as given. In such cases the gain or loss in the larger section is divided between the sections as they are given in the table in proportion to the mileage. The results given in the table are shown graphically in figure 3. In the figure the vertical scale represents gain in cubic feet per second per mile, and the horizontal scale represents distance from the upper measurements at Platte Canyon. The hatched columns show the gains in the first seven-year period, from 1889 to 1895. The solid columns show the gains in the second seven-year period, from 1896 to 1903, excluding 1897. The difference in the heights of the two columns for any section represents the increase or decrease in the return waters for that section in the second seven-year period over the return waters for the same section for the first seven-year period. The diagram shows that between Platte Canyon and Denver the return seepage was greater for the first seven-year period than for the second. This can be accounted for by the fact that water formerly carried in open ditches and used for irrigation in this section is now taken by the Denver Union Water Company into its pipe lines and used in the city of Denver for domestic purposes. In every section from Denver to the State line the gain in the second seven-year period is greater than that in the first. The smallest increase is in the sections from Evans to the Putnam ditch, and from the Putnam ditch to Fort Morgan. The largest increase is between Fort Morgan and Snyder, and the next largest between Iliff and Crook. The small increase in gain between Evans and Fort Morgan may be accounted for by the fact that along this part of the river there have been constructed many ditches to collect seepage water (Pl. II). A large part of the seepage water which would otherwise return to the stream is collected by these ditches and used for irrigation, and hence does not show in the measurements. The large increase in the sections below Fort Morgan is doubtless due to the fact that that part of the State is only now developing. The last two sections, from Iliff to the State line, showed losses in the first period and gains in the second period. The sands of the river bed seem to be getting filled so that water flows in the surface channels, where formerly it was all lost. Taken as a whole, the measurements give every reason to believe that the flow of the stream in the lower reaches is increasing and will continue to do so. Up to the present time there has been very little storage of water and consequent irrigation in the late summer below the mouth of the Cache la Poudre. During the year 1904 two large reservoirs were constructed in this section, and plans for other reservoirs are being made. The filling of these reservoirs will make possible the use of

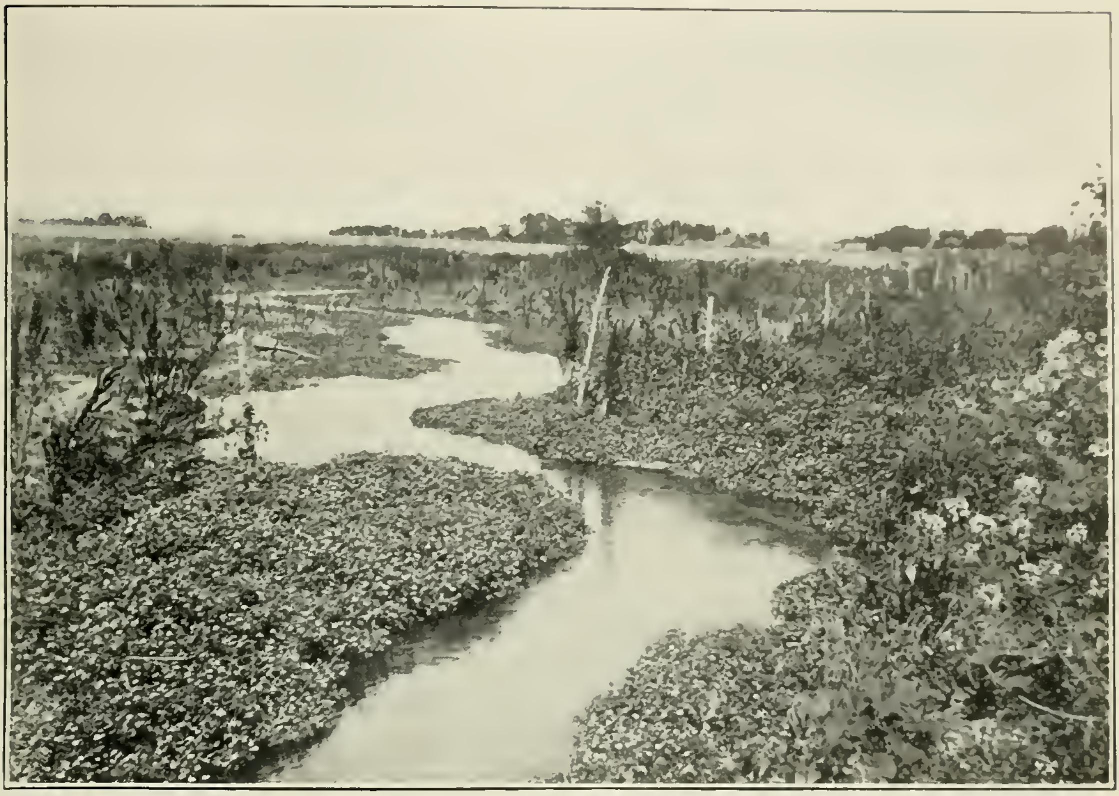

FIG. 1.—A CHARACTERISTIC SEEPAGE DITCH.

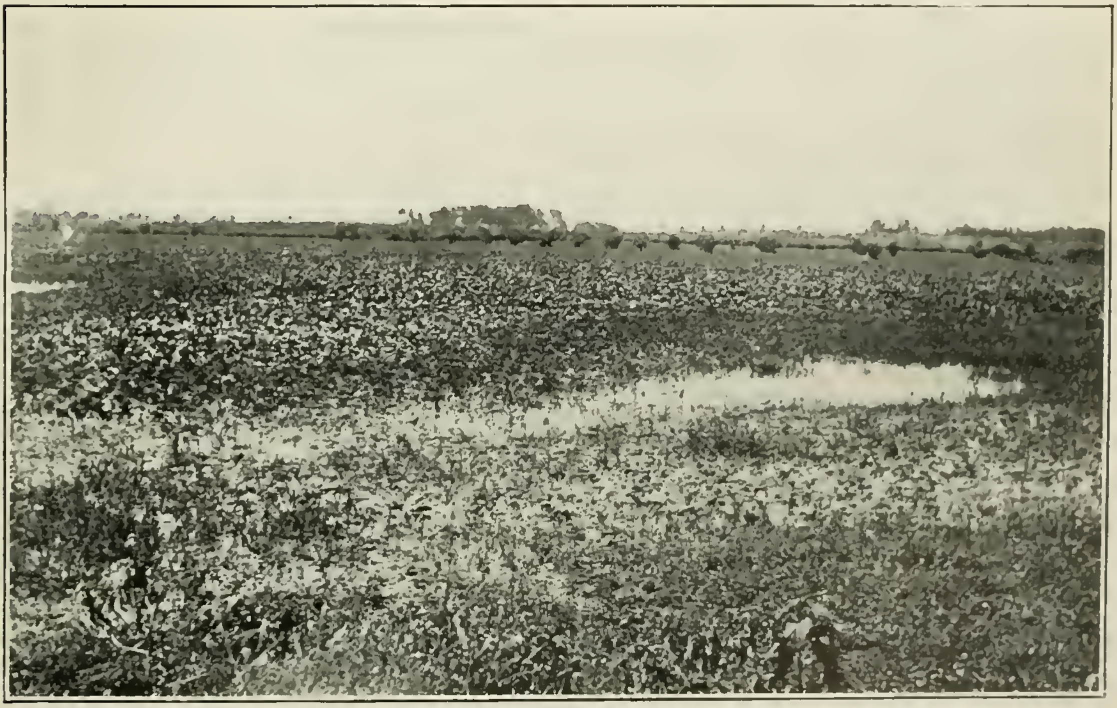

FIG. 2.—SEEPED SUGAR-BEET FIELD.

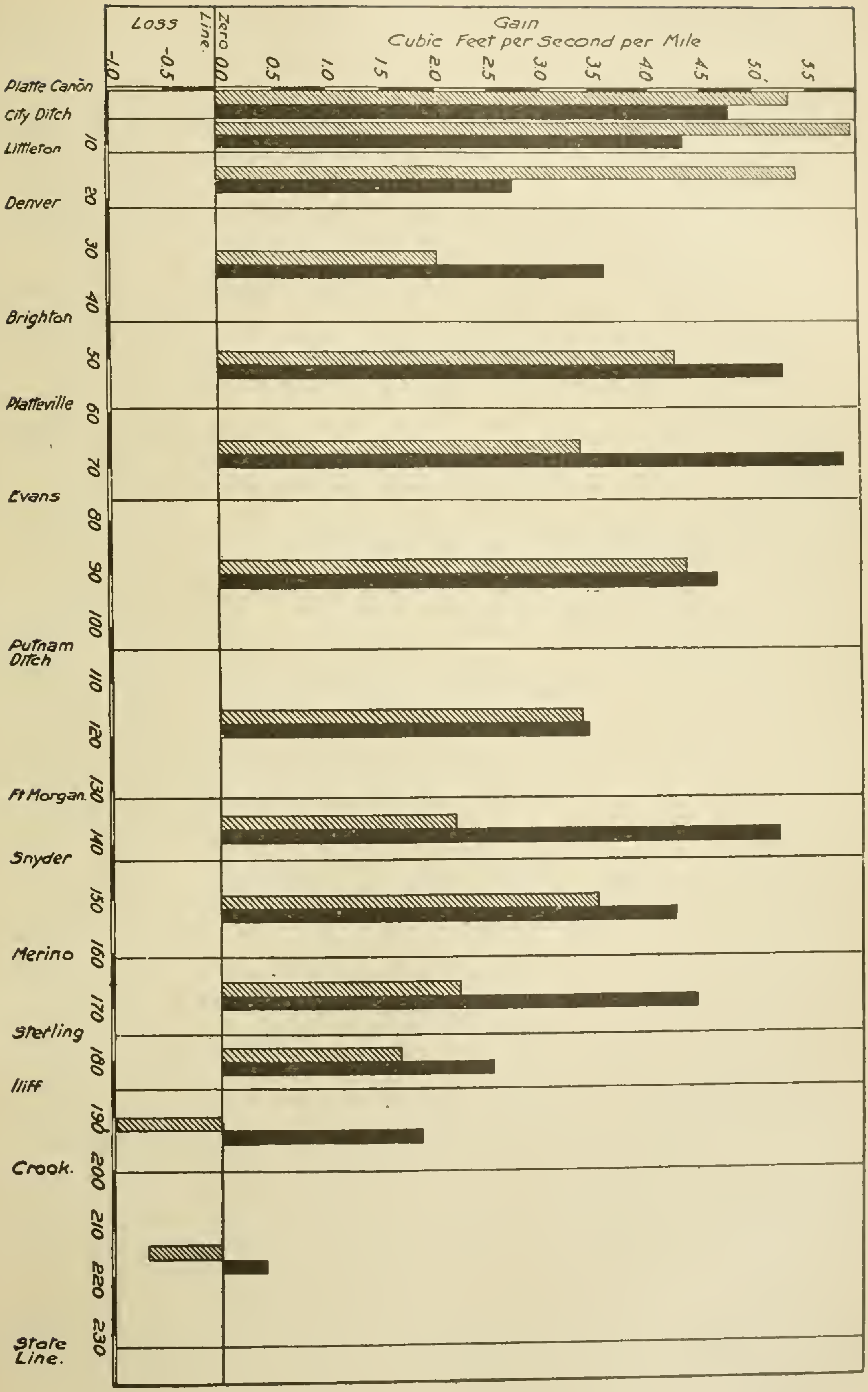

FIG. 3.—Diagram comparing volume of return seepage to South Platte River for two seven-year periods, 1889–1895 and 1896–1903, excluding 1897.

much more water in the late summer, thus keeping the soil along the stream filled with water, which will gradually find its way toward the stream.

The measurements reported in the previous tables cover periods only long enough to allow those making the measurements to travel along the course of the stream and make the measurements. All of these measurements have been made in the fall of the year when the flow is naturally small and when it is considered that most of the water in the stream comes from return seepage. These measurements are based upon the supposition that the party making the measurements will progress at about the same rate as the flow of the stream, so that any changes in that flow will not affect the results, but means have been adopted in each case to take into account any changes which might have occurred in the flow of the stream—over night, for instance. A gauge was set at night, and if there had been any change during the night new measurements were made in the morning.

It is believed, however, that records for a single day or for a few days are valuable chiefly because they are the only ones available. They are, nevertheless, conclusive as to the fact that there is a large return to the stream from this source. During the season of 1903 Mr. Adams obtained from the water commissioners of the various districts included within the drainage area of the South Platte and its tributaries daily records of the quantities of water diverted by the ditches within their respective districts. These records are more or less complete, some commissioners keeping records of the flow of all the ditches, others measuring only the larger ditches and those which it was necessary for them to regulate. Small ditches with early rights or those supplied by seepage and so located on the river that their diversions interfered with no one else were not measured in many cases. The records in district 8, which includes the section of the river from the canyon to Denver, are very largely estimates made by the water commissioner and can not be considered as accurate for the daily flow, although they probably approach accuracy for the average flow of the ditches for various months. The records in district 2, extending from Denver to the mouth of the Cache la Poudre, are practically complete and are probably quite accurate. The records in district 1, which includes the river from the mouth of the Cache la Poudre to the east line of Morgan County, are also fairly complete. Those of district 64, which extends from the east line of district 1 to the State line, are much less complete and accurate. There are a number of ditches in this district which have no decreed rights and are below any ditches which have such rights, and consequently the water commissioner paid no attention to their diversions. On the tributaries the records of the diversions by the larger ditches are fairly complete, but in each district there is a large number of small ditches with early rights for which there are no records, so that the measurements on these tributaries can not be used in the computations of the return seepage. The flood period in the South Platte and its tributaries is usually in June. At this time flood water flows from these tributaries into the Platte and there are no measurements at their mouths, and therefore an accurate record of the supply in the main stream for the month of June can not be secured. During the months of July and August the reported diversions by the large ditches on the tributaries of the Platte leave so narrow a margin for supplying the small early ditches that it is fair to conclude that the entire flow of these tributaries is diverted during those months, and whatever water reaches the Platte from them is seepage water from the lands close to the river. For these two months, therefore, the records of flow and diversions on the South Platte will give a fair idea of the amount of return seepage in the river. The records of the stream flow are taken from the report of the United States Geological Survey (Water Supply and Irrigation Paper No. 99). Records have been kept by the Survey at South Platte, which is above all diversions; at Denver, which is on the line between districts 8 and 2; at Kersey, which is on the line between districts 2 and 1; and at Julesburg, which is at the lower end of district 64. This divides the river into three sections, one from the South Platte to Denver, which includes district 8; one from Denver to Kersey, which includes district 2; and one from Kersey to the State line, which includes districts 1 and 64. In the tables which follow the measurement at the upper station of each section gives the supply for the ditches within the section. The difference between the stream flow at the upper station and the sum of the diversions and the flow at the lower station represents the gain or loss in the section. The results of these computations are shown in the following tables. The first table gives the results for July and the second for August, 1903. These tables are based upon the supposition that none of the natural flow of the tributaries reaches the main stream. Measurements of the flow and diversions of these tributaries are complete enough to show that this is a fair assumption.

Return seepage to South Platte River, July, 1903, in cubic feet per second.

[In cubic feet per second.]

South Platte to Denver:		
River at South Platte		353
Diversions	165	
River at Denver	328	
		493
Gain		140
Percentage of gain		39.66
Denver to Kersey:		
River at Denver		328
Diversions	631	
River at Kersey	192	
		823
Gain		495
Percentage of gain		150.90
Kersey to Julesburg:		
River at Kersey		192
Diversions	636	
River at Julesburg	3	
		639
Gain		447
Percentage of gain		232.81
River as a whole:		
River at South Platte		353
Diversions	1,432	
River at Julesburg	3	
		1,435
Gain		1,082
Percentage of gain		307.08

Return seepage to South Platte River, August, 1903, in cubic feet per second.

South Platte to Denver:		
River at South Platte		217
Diversions	146	
River at Denver	108	
		254
Gain		37
Percentage of gain		17.05
Denver to Kersey:		
River at Denver		108
Diversions	384	
River at Kersey	137	
		521
Gain		413
Percentage of gain		382.41

Kersey to Julesburg:		
River at Kersey		137
Diversions	302	
River at Julesburg	130	
		432
Gain		295
Percentage of gain		215.33
Stream as a whole:		
River at South Platte		217
Diversions	833	
River at Julesburg	[a]130	
		963
Gain		746
Percentage of gain		343.73
Gain, excluding flow at Julesburg		616
Percentage of gain, excluding flow at Julesburg		283.41

The tables show that for July, on the stream as a whole, the average gain for the whole stream between South Platte and the State line is 1,082 cubic feet per second, and the diversions are slightly more than four times the supply at the upper station. For August the average gain, excluding a large flow at Julesburg, which was due to local rains, is 616 cubic feet per second, and the average diversions were nearly three times the supply at the upper station.

These records show, however, that very little surface flow from either the natural flow of the stream or return seepage passes the State line. The average for July is but 3 cubic feet per second and that for August 130 cubic feet per second, but this high average is due to a large flow on a very few days caused by heavy local rains. The average flow for the month of August outside of these few days is but little larger than that for July.

The fact that the tributaries of the Republican River rise so close to the South Platte and the fact that the stream has from the earliest settlement gone dry or nearly so in the sections below the mouth of the Cache la Poudre, have given rise to the belief that the water of the Platte sinks into the sand and finds its way into the tributaries of the Republican. To test the correctness of this theory Mr. W. W. Follett, under the direction of the late Col. E. S. Nettleton, made a series of measurements in 1891.[b] The water levels in lines of wells crossing the valley of the South Platte at various points were measured to determine whether or not the water-bearing strata were above or below the level of the Platte at the points crossed. Mr. Follett's measurements show that west of the Colorado-Nebraska line the water in the wells measured and in the Frenchman branch of the

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[a] Largely due to heavy local rains August 16 and 23.

[b] 52d Cong., 2d Sess., Ex. Docs. 41, 42.

Republican is above that of the Platte, and his conclusion is that this water comes from local precipitation. On the other hand, the water in the wells on a line passing north and south through North Platte is in a gravel stratum on a level with or below the South Platte, which extends to the tributaries of the Republican.

While these measurements are not conclusive, since the wells observed west of the State line do not go below the level of the Platte, and therefore do not prove that the water from the river does not get away to the south on a level lower than the wells, they seem to indicate that in Colorado the water of the Platte is retained in its own valley, either in the surface stream or as an underflow, and that somewhere between the State line and North Platte the water begins to flow away from the valley as underflow and contributes to the flow of the tributaries of the Republican. The measurements made by Mr. Follett east of North Platte showed that these conditions exist along the river as far as Grand Island, where the measurements were discontinued.

The measurements of return seepage given in the table seem to bear out Mr. Follett's conclusions as regards the stream in Colorado. Irrigation along the stream has brought about a gradual increase in return waters which has now reached the State line. Mr. Follett's measurements give reason to suppose that this increase will not be as rapid in Nebraska as it has been in Colorado, on the supposition that not all the water used in the valley of the Platte will be retained within the valley, either in the surface stream or the sands of the valley. The volume of return water in the surface streams will depend upon whether the supply added to the underground water by irrigation is greater than that which is lost through the underflow into the tributaries of the Republican and by evaporation. The velocity of underflow is supposedly very slow, and a large use of water in irrigation would probably supply it faster than it could be carried away by this underflow and would tend to produce a flow in the river. On the other hand, the bed of the stream in Nebraska is broader than it is above and evaporation will always be a source of great loss.

The general conclusion regarding the effect of irrigation in Colorado upon the supply of water in Nebraska is that the use of the water of the Platte in Colorado has reduced the size of the spring floods, and also to a less extent the flow in the late summer, but this summer flow has always been very unreliable. At present the improvement in the flow of the stream during the late summer due to return seepage has reached the State line and may be expected to continue down the stream. In that case the conditions along the stream in Nebraska will be better than they have ever been before. The floods will be less, but the supply after the floods have subsided will be more reliable. Under the present arrangements there are irrigated from the South Platte and tributaries in Colorado about 750,000 acres of land yielding annual crops worth from $15 to $1,000 per acre,[a] supporting a large population in comfort, not only without working any lasting harm to the farmers in Nebraska, but actually improving their water supply. Stopping the use of the water in Colorado might increase the supply in Nebraska for a few years, until the water supplied to the soil by years of irrigation had drained out, but there is every reason to believe that eventually the river would return to its former condition, and Nebraska would receive no lasting benefit, while Colorado would suffer the loss due to the return of 750,000 acres from intensively cultivated and highly productive farms to their original desert condition or worse, because the natural grasses have been destroyed. This would involve the loss of the capital invested in irrigation works, in railroads, in sugar factories, in farm buildings and implements, and in all the industries and business enterprises which are supported by a prosperous agricultural community. It would mean the ruin of other industries which now run on a narrow margin of profit, because of the increased cost of living due to the stopping of the local production of a food supply.

Even assuming that the natural flow of the stream would reach Nebraska if it were not used in Colorado, its use in Nebraska would necessitate the construction of new canals, farm buildings, grain elevators, mills, sugar factories, business houses, and residences. All over the United States the development of new sections by irrigation has been attended with financial losses and misunderstandings and recriminations between investors in irrigation works and the settlers under these works. The South Platte Valley in Colorado has passed through this period. At present 85 per cent of the land in the valley is watered by ditches owned by the farmers, and a satisfactory and economical system of ditch management has been worked out. This condition has been reached only after years of trouble between investors and settlers.

Under present conditions the water used on the lands near the headwaters returns in part to the streams to be used again farther down along their courses. This process continues down to the State line and will probably extend on into Nebraska. Supposing the use in Colorado is stopped and supposing the water reaches Nebraska, the return seepage, which will not be as great as it is in Colorado (see p. 56) will reach the stream below where water is needed for irrigation, and there will be but one use of water where now it is used over and over.

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[a] Mr. Adams collected complete crop returns for 24,329 acres, showing annual returns of $19.84 per acre. This land was not in the most highly productive section of the valley. The area planted to sugar beets in 1903 was 15,973 acres, with an average production of 13.46 tons per acre. At $4.50 per ton, the usual price, this is $60.57 per acre, a total of $967,484 for the whole area. Raspberries yielded as high as $1,018 per acre, potatoes $80 to $85 per acre, and alfalfa $15 per acre. The acreages of these various crops are not available, hence no statement of total crop returns can be made.

Considered from an economic standpoint, the maintenance of the present status means the largest possible use of the water supply, since irrigation begins where the streams issue from their canyons, allowing the fullest opportunity for seepage return to the streams. It means the preservation of the homes and industries of the South Platte Valley in Colorado and the maintenance of the institutions which are the outgrowth of nearly a half century's experience, while Nebraska will receive a gradually increasing supply of water, which will eventually be better than would result from the stopping of irrigation in Colorado.

RIGHTS TO WATER FRON NORTH PLATTE RIVER AND TRIBUTARIES.

COLORADO.

The course of the North Platte lies in three States. The nature of rights to the use of water in Colorado has been discussed on page 26. In Wyoming, up to 1890, rights were acquired by diverting water and using it, but since that time they have been acquired by securing a permit from the State engineer, constructing works, and using the water. Rights acquired prior to 1890 are defined by the board of control, on the testimony of the interested parties and on surveys and measurements made by the State engineer and his assistants. Water-right holders are entitled to sufficient water for stated areas, with the limitation that no more than 1 cubic foot per second can be used for 70 acres.

The North Platte and its tributaries in Colorado are in districts 46 and 47. Irrigation began in these districts in the early eighties and the rights were first adjudicated in 1892. The records of these adjudications show that in both districts the rights were based on the areas actually irrigated and were computed on the assumption that in district 46 one cubic foot per second will supply 40 acres and in district 47 it will supply 50 acres. Where a right computed in this way exceeded the capacity of the ditch which served the land the right was limited to the capacity of the ditch.

Second adjudications took place in 1900 for district 46 and in 1902 for district 47. In these adjudications the rights of those who were not represented in the first one and of those who acquired rights since these adjudications were defined. They were computed in the same way as in the first adjudications, except that the duty of water was differently estimated. Testimony was introduced to show that 100 acres of bottom land required 2 cubic feet of water per second; 100 acres of upland required 2.5 cubic feet of water per second, except along the Canadian River, where 100 acres required 3 cubic feet of water per second. These estimates were followed in computing the rights in the second adjudication. Although these rights were based upon the acreages actually irrigated, their owners are held to have rights to fixed quantities rather than to sufficient water for the lands irrigated. Any economy in use on their part would, therefore, give them a surplus of water which could be disposed of by them rather than left in the stream to supply lands lying farther down on the stream. Rights in these districts, as defined in the decrees above referred to, are shown in the following table:

Rights decreed from North Platte River and tributaries in Colorado, districts 46 and 47.

Date of priority.	Area irrigated.	Rights decreed.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*
1880	200	4.00	4.00
1881	100	2.50	6.50
1882	775	26.50	33.00
1883	2,180	44.00	77.00
1884	2,235	46.50	123.00
1885	6,925	136.00	259.50
1886	4,670	99.00	358.50
1887	18,375	381.05	739.55
1888	24,913	568.55	1,308.10
1889	16,292	363.50	1,671.60
1890	13,080	292.25	1,963.85
1891	5,375	106.00	2,069.85
1892	170	4.00	2,073.85
1893	3,780	93.56	2,167.41
1894	3,335	82.45	2,249.86
1895	1,980	49.05	2,298.91
1896	1,490	32.47	2,331.38
1897	2,840	69.60	2,400.98
1898	4,025	113.55	2,514.53
1899	1,240	39.90	2,554.43
1900	5,100	127.50	2,681.93
1901	3,350	67.25	2,749.18
Total	122,430	2,749.18	

WYOMING.

The rights to the tributaries of the North Platte in Wyoming have been adjudicated by the board of control, but those to the river itself have not been. The various streams are independent of each other, but the rights to water from them are subject to prior rights on the main stream. They can not therefore be considered absolutely settled until the main stream is adjudicated and a general table for the stream and its tributaries is made up. They are, however, practically settled, because the main stream supplies sufficient water for existing rights, and any rights acquired in the future will be subsequent to the rights on the tributaries. In making up this table the river is divided into three sections. The upper section extends from the Colorado line to Fort Steele, the middle section from Fort Steele to Guernsey, and the lower section from Guernsey to the Wyoming-Nebraska line.

Rights to water from the tributaries of North Platte River in Wyoming.

Date of priority.	Upper section.	Middle section.	Lower section.	Total.	Total area irrigated.
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*	*Acres.*
1868		0.54	1.00	1.54	
1869			1.57	1.57	110
1870		.53		.53	
1871		1.71	31.00	32.71	2,290
1872			1.97	1.97	138
1873		.75	6.26	7.01	495
1874		5.35	14.71	20.06	1,270
1875	2.30	4.10	20.61	27.01	1,868
1876	3.60	4.40	52.17	60.17	4,189
1877		5.43	27.64	33.07	2,313
1878	14.75	8.27	53.97	76.99	5,377
1879	23.80	37.11	26.13	87.04	6,100
1880	3.42	7.72	40.61	51.75	3,607
1881	11.08	15.50	119.62	146.20	10,280
1882	40.91	31.63	72.51	145.05	10,100
1883	25.37	68.04	745.99	839.40	58,706
1884	92.93	79.00	241.67	413.60	28,870
1885	141.89	280.64	193.36	615.89	42,869
1886	63.11	187.04	135.04	385.19	26,807
1887	81.23	92.97	238.57	412.77	28,697
1888	66.11	60.41	167.46	293.98	20,531
1889	54.88	57.01	44.60	156.49	10,877
1890	41.33	31.36	148.40	221.09	15,456
1891	53.82	30.32	30.72	114.80	8,007
1892	13.98	28.54	36.28	78.80	5,501
1893	9.77	33.37	2.28	45.42	3,243
1894	27.60	12.26	21.51	61.37	4,300
1895	56.20	62.84	37.77	156.81	10,975
1896	17.74	124.60	27.80	170.14	11,910
1897	18.68	72.81	16.60	108.09	7,559
1898	20.12	98.65	13.18	131.95	9,234
1899	23.30	87.48	11.67	122.45	8,577
1900	3.14	44.33	9.21	56.68	3,967
1901	8.86	69.43		78.29	5,480
Total	919.92	1,644.14	2,591.88	5,155.94	359,673

There are on record in the State engineer's office several claims to water from the main stream filed before the adoption of the present law, and also a large number of approved applications filed under the present law. No certificates of completed appropriations can be issued until an adjudication is had in which the rights acquired under the Territorial laws have been defined. The records show, however, where proof of completion has been made and what permits have been canceled. The following table, made up from the records of the Wyoming State engineer's office, shows the status of rights so far as that office is concerned:

Rights to water from North Platte River in Wyoming, as shown by the records of State engineer's office.

Year.	Works completed.		No final action.		Territorial claims.		Total in force.	
	Acres.	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*
1875					1,080	264.50		
1880					215			
1882					700			
1883					5,360	106.22		
1885					12,680	92.39		
1886					15,996			
1888					3,200			
1889					1,700			
1890					671,800	9,554.00		
1891			11,500	164.3	1,000,000	4,500.00	11,500	164.3
1893	11,080	158.3	280	4.0			11,360	162.3
1894	800	11.4	15,560	222.2			16,360	233.7
1895	20	.3	10,493	149.9			10,513	150.2
1896	204	2.9	3,000	43.0			3,204	45.9
1897	166	2.4					166	2.4

Rights to water from North Platte River in Wyoming, etc.—Continued.

Year.	Works completed.		No final action.		Territorial claims.		Total in force.	
	Acres.	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*	*Acres.*	*Cu.ft.per second.*
1898	2,195	31.4	781	11.1			2,976	42.5
1899	200	3.0					200	3.0
1900	199	2.8					199	2.8
1901	275	4.0	20,170	288.0			20,445	292.0
1902	550	7.9	63,883	912.6			64,433	920.5
1903			2,132	30.6			2,132	30.6
1904[a]			51,144	730.6			51,144	730.6
Total	15,689	224.4	178,943	2,556.3			194,632	2,780.8

[a] To August 15.

The rights given in the table as completed can be considered as settled, except as to the number and volume of prior rights: part of those on which no action has been taken will be canceled, while a part are probably good. For those dated 1901 and later there is yet considerable time in which to complete the work authorized. The larger claims filed under the Territorial law are of no account, as the works were never built. Some of the smaller claims probably are good. There is little irrigation along the stream, except in the section just above the Wyoming-Nebraska line. Since the rights have not been defined, no exact statement as to their volume or date of acquirement can be made. Under the Wyoming laws an appropriator is entitled to sufficient water for the land which he has irrigated, with a limit of 1 cubic foot per second to 70 acres. A table has been made up showing approximately the areas irrigated along the stream, and the quantities of water to which the owners of these lands are entitled have been computed on the basis of 1 cubic foot per second for 70 acres. This is shown in the following table. In making up this table the river was divided into three sections, as in the table showing the rights to the tributaries. The Mitchell ditch, which diverts water just above the Wyoming-Nebraska line for use in Nebraska, is not included.

Approximate appropriations by ditches in Wyoming from North Platte River.

Date of priority.	Upper section.	Middle section.	Lower section.	Total appropriations.	Sum to date.	Total area irrigated.
	Cu.ft.per second.	*Cu.ft.per second.*	*Cu.ft.per second.*	*Cu.ft.per second.*	*Cu.ft.per second.*	*Acres.*
1885	45.72		14.28	60.00	60.00	4,200
1886			5.00	5.00	65.00	350
1887	5.00			5.00	70.00	350
1888	16.29	10.00	50.00	96.29	146.29	5,340
1891			41.45	41.45	187.74	2,900
1893		11.45	70.00	81.45	269.19	5,700
1894		11.45		11.45	280.64	800
1895		1.15		1.15	281.79	80
1896		2.92		2.92	284.71	204
1897		2.37		2.37	287.08	166
1898	7.15	7.00		14.15	301.23	990
1899		5.00	2.86	7.86	309.09	550
1900			5.00	5.00	314.09	350
1901	3.58		400.00	403.58	717.67	28,250
1902	34.57	3.45		38.02	755.69	2,661
Total	112.31	54.79	588.59			52,891

Taking the estimate for the rights initiated before 1891, when the present law became operative, from the above table and the records of the engineer's office for the rights initiated since that time gives a total of 2,927 cubic feet per second as the rights to water from the North Platte in Wyoming. The rights to water from the tributaries aggregate 5,155.94 cubic feet per second.

One of the tributaries of the North Platte—the Laramie River—is also an interstate stream and, so far as Colorado and Wyoming are concerned, is entirely independent of the North Platte. The Laramie River in Colorado is in district 48. The rights to water in this district were adjudicated in 1896. The decree states the number of acres of land irrigated by each ditch, and awards to each "—— cubic feet of water per second of time, or so much thereof as may be necessary to irrigate —— acres of land." The number of acres of land in each case is the number found to be irrigated by the ditch. The right is thus restricted to the needs of a given area of land within the maximum limit fixed by the decree. This form of decree is exceptional in Colorado and places rights substantially on the same basis as in Wyoming; that is, the appropriator has not a right to a fixed quantity of water, but to sufficient water for his land which he has irrigated at the time of the making of the decree.

This form of decree prevents probably the worst abuse which has arisen under the water laws of Colorado. In other districts the courts decreed rights to volumes much larger than had ever been used by the holders of rights. In later years the use was enlarged by the holders of these excessive decrees, thus depriving those who have been using water perhaps for years and long prior to the increased use by the holders of early rights. Under the decree in district 48 this is impossible, as the water-right holder has only a right to irrigate a fixed area. The maximum limits fixed in the decree seem to bear no relation to the areas irrigated by the ditches. In most cases they equal the full capacities of the ditches, as stated by their owners. One exception to the general wording of the decree was made in the case of the Laramie River ditch, which carries water from the Laramie into the Cache la Poudre. The decree gives to the owners of this ditch the right to 400 cubic feet per second of water from the Laramie and its tributaries for direct irrigation, and the right to store 500,000,000 cubic feet of water annually. The following table gives the areas stated in this decree, together with the maximum quantities of water which can be diverted for their irrigation:

Decreed rights to water from Laramie River, in Colorado.

Year.	Area irrigated.	Maximum volume decreed.	Sum to date.	Year.	Area irrigated.	Maximum volume decreed.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*		*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1880	300	30.84	30.84	1891	[a]30,000	[a]400.00	649.20
1881	635	51.23	82.07	1892	280	7.40	656.60
1882	795	58.18	140.25	1893	300	25.14	681.74
1883	920	39.56	179.81	1894	400	39.22	720.96
1884	540	37.94	217.75	1896	385	24.53	745.49
1887	640	14.50	232.25				
1888	80	3.07	235.32	Total	35,535		
1890	260	13.88	249.20				

[a] All this acreage is in district 3 and the entire appropriation is for Laramie River ditch. Water from other sources also is used in the irrigation of this land.

Rights to the Laramie River in Wyoming were adjudicated in 1903. According to the usual practice in Wyoming, the decree determined the areas irrigated by the various claimants, and these claimants are entitled to sufficient water for the tracts irrigated, with a limit of 1 cubic foot per second for 70 acres. The following table gives the areas and the volumes to which they are entitled on this basis:

Rights to Laramie River in Wyoming.

Year.	Area.	Volume.	Sum to date.	Year.	Area.	Volume.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*		*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1875	318.00	4.54	4.54	1889	213.00	3.04	950.26
1877	1,325.00	18.93	23.47	1890	5,140.00	73.43	1,023.69
1878	235.00	3.36	26.83	1891	1,553.50	16.48	1,040.17
1879	920.00	13.14	39.97	1892	2,390.00	34.14	1,074.31
1881	2,686.07	38.37	78.34	1894	196.00	2.80	1,077.11
1882	1,284.00	18.34	96.68	1895	1,680.00	24.00	1,101.11
1883	42,042.05	600.60	697.28	1896	1,128.70	16.12	1,117.23
1884	9,018.00	128.83	826.11	1897	904.00	12.91	1,130.14
1885	1,516.00	21.66	847.77	1898	240.00	3.43	1,133.57
1886	1,948.00	27.97	875.74	1899	50.00	.71	1,134.28
1887	2,299.00	32.84	908.58				
1888	2,425.00	38.64	947.22	Total	79,111.32		

NEBRASKA.

Nebraska, like Wyoming, grants sufficient water to irrigate a given area rather than a fixed volume of water. The rights to the North Platte were adjudicated soon after the passage of the law of 1895. The owners of ditches commenced prior to 1895 filed claims under the law of 1889. Those commencing ditches after that date had filed applications with the State board and received permits to proceed with the work. The secretary of the board and his assistants made surveys and prepared maps of the river, the ditches, and the irrigated lands. Hearings were then held at various points by the secretary of the board. At these hearings, in addition to the submission of the sworn statements of claims, evidence was introduced by the various parties. When a ditch owner had filed a claim in accordance with the law of 1889, his right was held to date from the filing of the claim, otherwise from the date of first use of the water. Many of the ditches begun prior to the passage of the law of 1895 had not been completed at the time of the hearing, and those built on permits from the State board were also unfinished. In the case of the rights initiated before 1895 the board determined the plans of the applicants and based their rights on these plans, fixing the time within which the water should finally be applied to the land. The permits issued by the board in a similar way stated the time within which the water should be put to use. The adjudication, therefore, was not final as regards rights acquired either before or after 1895. In the case of the Farmers' Irrigation District *v.* Frank[a] the supreme court of the State has held that the board had no power to grant rights to parties constructing ditches prior to 1895, and that its function was merely to determine existing rights. Applying this ruling to the adjudications made by the board on the North Platte, the court held that the Farmers' Irrigating Company has a right to the full amount which the board determined that it would acquire by the completion of its works and applying water to the land by September 1, 1904. This company built only a small section of its ditch and reclaimed a very small area of land. Since the decision of the board no more work has been done and very little more land has been reclaimed, yet under this ruling of the court the ditch has a right to the full quantity of water and can lose this right only by ten years' nonuse.[b] Many other rights along the North Platte are in the same condition. The following table gives the rights as determined by the board. In the table rights initiated prior to 1895 and the applications approved since that date are given separately.

Rights to water from North Platte River in Nebraska.

Date of priority.	Appropriation.	Area to be irrigated.
	Cubic feet per second.	*Acres.*
Rights conditionally granted:		
1884	156.16	10,931
1887	1,142.86	80,000
1888	211.43	14,800
1889	532.67	37,287
1890	85.06	5,954
1891	30.86	2,160
1892	275.37	19,276
1893	471.85	33,030
1894	1,040.41	72,830
1895	217.63	15,234
Total	4,164.30	291,502
Applications approved:		
1895	104.48	7,313
1896	147.55	10,328
1897	530.00	37,100
1899	400.00	28,000
Total	1,182.03	82,741

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[a] 100 N. W., p. 286.

[b] Since this was written work has been resumed, and the canal is being extended according to the original plan.

The rights to the main Platte River in Nebraska are given in the following table:

Rights to water from Platte River in Nebraska.

Date of priority.	Appropriation.	Area to be irrigated.
	Cubic feet per second.	*Acres.*
Appropriations conditionally granted:		
1890	[a] 200.00	
1894	3,346.24	234,237
1894	[a] 240.00	
1895	945.72	66,200
Total	4,731.96	300,437
Applications approved:		
1896	214.00	14,980
1897	242.14	16,950
1900	289.64	20,275
Total	745.78	52,205

[a] For irrigation and power.

INTERSTATE RELATIONS.

COLORADO-WYOMING.

Statements of the rights to the North Platte in the States of Colorado and Wyoming are given on pages 60, 61. Only the rights on the main stream in Wyoming are in any way dependent on the use of the water in Colorado, and in the table given below the rights in Wyoming are those to water from the main stream rather than to the stream and its tributaries.

Rights to the North Platte River in Colorado and Wyoming.

Year.	Colorado.		Wyoming.	
	Rights acquired.	Sum to date.	Rights acquired.	Sum to date.
	Cubic feet per second.	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1880	4.00	4.00		
1881	2.50	6.50		
1882	26.50	33.00		
1883	44.00	77.00		
1884	46.50	123.50		
1885	136.00	259.50	60.00	60.00
1886	99.00	358.50	5.00	65.00
1887	381.05	739.55	5.00	70.00
1888	568.55	1,308.10	76.29	146.29
1889	363.50	1,671.60		146.29
1890	292.25	1,963.85		146.29
1891	106.00	2,069.85	164.30	310.59
1892	4.00	2,073.85		310.59
1893	93.56	2,167.41	162.30	472.89
1894	82.45	2,249.86	233.70	706.59
1895	49.05	2,299.91	150.20	856.79
1896	32.47	2,331.38	45.90	902.69
1897	69.60	2,400.98	2.40	905.09
1898	113.55	2,514.53	42.50	947.59
1899	39.90	2,554.43	3.00	950.59
1900	127.50	2,681.93	2.80	953.39
1901	67.25	2,749.18	292.00	1,245.39
1902			920.50	2,165.89
1903			30.60	2,196.49
1904			730.60	2,927.09

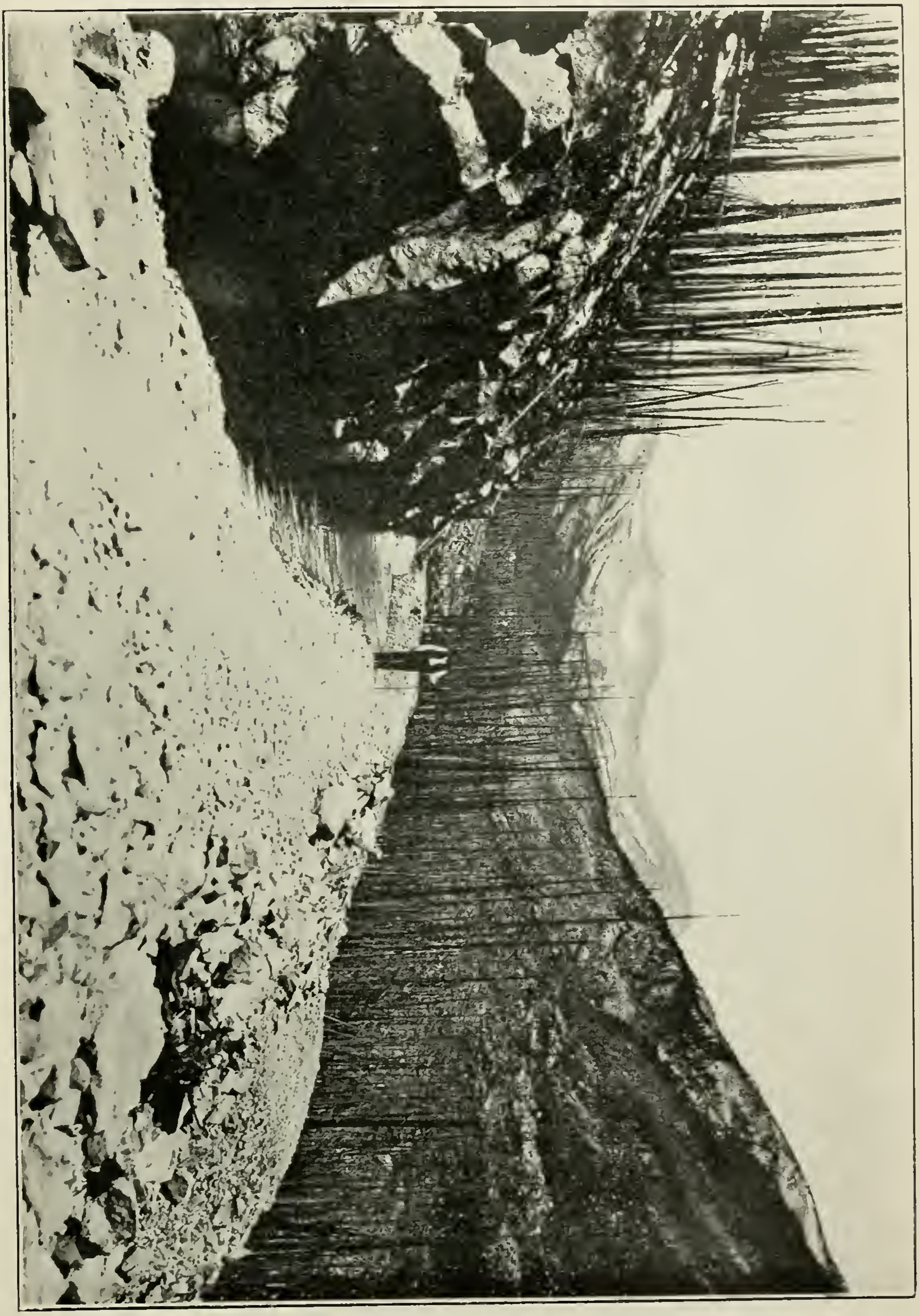
This table shows that the first rights in Wyoming were acquired in 1885, and that prior to this there were in Colorado rights to 123.5 cubic feet per second. The principal volume of the rights in Colorado were acquired in the years 1885 to 1891, more than two-thirds of the rights dating in these years. These are all prior to any considerable volume of rights in Wyoming. The greater part of the rights in Wyoming were acquired since 1900 and subsequent to practically all the rights in Colorado. As between the two States, therefore, Colorado has the earlier rights to the river.

Natural conditions are such that there is little likelihood of any conflict between appropriators in the two States. Most of the land irrigated in Colorado is in small areas immediately adjoining the stream and sloping rapidly toward the stream, and a large part of the water applied will soon return to the river. Practically the only crop raised is native hay, which requires water only during the flood season, when there is no shortage anywhere along the river. For 30 miles north of the State line the river runs through a succession of canyons and between hills, which prevent its diversion for irrigation, while in this distance a number of tributaries discharge into the river. The valley then widens out somewhat, and in the course of the next 10 miles to the town of Saratoga considerable land is irrigated, and further development will probably take place in this region. Applications for large appropriations have recently been filed with the State engineer. From the vicinity of Saratoga the North Platte flows for 250 miles with almost no ditches diverting its water. In this section there are a number of tributaries to the river. In the last 30 miles of the river's course in Wyoming the valley widens out, and most of the appropriations from the North Platte in Wyoming are in this section.

Because of the long distance between this irrigated valley and Colorado it is not probable that use in Colorado will affect Wyoming irrigators. The appropriators in Colorado were undoubtedly decreed rights very much in excess of what they have ever used, but natural conditions are such that they can not make such an increased use of the water as to deprive appropriators in Wyoming.

Laramie River.—So far as Colorado and Wyoming are concerned, the Laramie River is independent of the North Platte. As shown on page 62, rights to the Laramie River in the two States were determined on the same basis. With one exception appropriators in both States are given the right to sufficient water for certain areas of land.

The following table shows the rights to this stream in the two States. For Colorado the areas are given and the maximum quantities which may be diverted by the ditches serving these areas. As pointed out before, these maximum quantities bear no relation to the areas irrigated. For Wyoming the areas are given and the maxi-



SKY-LINE DITCH, CARRYING WATER FROM LARAMIE RIVER DRAINAGE TO CACHE LA POUDRE DRAINAGE.

mum quantities of water on the basis of 1 cubic foot per second for 70 acres.

Rights to Laramie River in Colorado and Wyoming.

Year.	Colorado.			Wyoming.		
	Area.	Rights acquired.	Sum to date.	Area.	Rights acquired.	Sum to date.
	Acres.	*Cubic feet per second.*	*Cubic feet per second.*	*Acres.*	*Cubic feet per second.*	*Cubic feet per second.*
1875	----------	----------	----------	318.60	4.54	4.54
1877	----------	----------	----------	1,325.00	18.93	23.47
1878	----------	----------	----------	235.00	3.36	26.83
1879	----------	----------	----------	920.00	13.14	39.97
1880	300	30.84	30.84	----------	----------	39.97
1881	635	51.23	82.07	2,686.07	38.37	78.34
1882	795	58.18	140.25	1,284.00	18.34	96.68
1883	920	39.56	179.81	42,042.05	600.60	697.28
1884	540	37.94	217.75	9,018.00	128.83	826.11
1885	----------	----------	217.75	1,516.00	21.66	847.77
1886	----------	----------	217.75	1,948.00	27.97	875.74
1887	640	14.50	232.25	2,299.00	32.84	908.58
1888	80	3.07	235.32	2,425.00	38.64	947.22
1889	----------	----------	235.32	213.00	3.04	950.26
1890	260	13.88	249.20	5,140.00	73.43	1.023.69
1891	30,000	400.00	649.20	1,153.50	16.48	1,040.17
1892	280	7.40	656.60	2,390.00	34.14	1,074.31
1893	300	25.14	681.74	----------	----------	1,074.31
1894	400	39.22	720.96	196.00	2.80	1,077.11
1895	----------	----------	720.96	1,680.00	24.00	1,101.11
1896	385	24.53	745.49	1,128.70	16.12	1,117.23
1897	----------	----------	----------	904.00	12.91	1,130.14
1898	----------	----------	----------	240.00	3.43	1,133,57
1899	----------	----------	----------	50.00	.71	1,134.28
Total	35,535	----------	----------	79,111.32	----------	----------

The table shows that prior to 1880, when the first appropriation was made in Colorado, 2,798 acres had been irrigated in Wyoming, giving its owners the right to 40 cubic feet per second. There is little irrigation in Colorado in the valley of the Laramie and its tributaries, and diversions by ditches in this valley do not noticeably deplete the supply for Wyoming. There is, however, conflict over the diversions by the Water Supply and Storage Company of Colorado, which takes waters from the headwaters of the Laramie over the divide into the Cache la Poudre for use in the valley of that stream (Pl. III). While many others are interested in this contest, the settlers under the canals of the Wyoming Development Company are the principal users of water from the Laramie in Wyoming, and will be the chief sufferers from diversions in Colorado. The right of the Wyoming Development Company to water something over 35,000 acres is dated 1883, while the right of the Water Supply and Storage Company to 400 cubic feet per second was acquired in 1891, according to the Colorado decree. There are, prior to the right of the Water Supply and Storage Company, rights to irrigate 71,369 acres in Wyoming, giving a right to 1,019.56 cubic feet per second.

The following table giving the average flow of the Laramie River at Woods Landing, near the State line, shows that these rights in Wyoming would practically exhaust the supply of the stream. The measurements are taken from reports of the State engineers of Wyoming.

Mean discharge of Laramie River at Woods Landing, Wyo., 1889–1891 and 1896–1900.

	Cubic feet per second.
April	230. 60
May	1, 102. 15
June	1, 377. 20
July	379. 94
August	636. 27
September	78. 41

This diversion by the Water Supply and Storage Company stands on a different basis from the other rights as related to natural conditions as well as in its nature, as defined by the court. Much of the water diverted and used in the valleys of the headwaters of the Laramie returns to the streams as seepage and helps to supply rights in Wyoming. That diverted by the Water Supply and Storage Company, however, is carried into the drainage area of another stream and hence there is no return seepage.

Two series of measurements of return seepage have been made along the Laramie River. The first series, made by B. P. Fleming, of the Wyoming Experiment Station, shows that between Woods Landing, near the State line, and the tunnel of The Wyoming Development Company, below which there are few diversions, there is a gain in the flow of the stream of 13.08 cubic feet per second, or 0.16 cubic foot per second per mile. This gain is not sufficient to make any appreciable change in the flow of the river, but the measurements indicate that if water should be turned down from the upper ditches it would reach the ditches in Wyoming. The second series of measurements was made by C. E. Tait, of this Office. Mr. Tait's measurements show a slightly larger gain—21.64 cubic feet per second, or 0.22 cubic foot per second per mile. These measurements, like the others, indicate that water, if turned down the stream, would not be lost to the lower ditches.

Sand Creek, a tributary of the Laramie, is also an interstate stream. There are few diversions for use in the valley of Sand Creek in Colorado, but its water, like that of the Laramie, is diverted into the headwaters of the Cache la Poudre. This diversion was made in 1902 and is, therefore, later than all the rights in Wyoming. As in the case of the Laramie, none of this water diverted will return as seepage to Sand Creek. Wyoming appropriators brought suit against the Colorado parties making these diversions, and an injunction has been granted restraining the Colorado parties from diverting the waters of Sand Creek on the ground that "the right to divert running waters for irrigating lands in an arid country is not controlled or affected by political divisions."[a]

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[a] Hoge *v.* Eaton, 135 Fed., 411.

WYOMING-NEBRASKA.

Theoretically and on the assumption that State lines should be ignored all rights to the North Platte and its tributaries in both Colorado and Wyoming are subject to prior rights in Nebraska. In the table given below the rights in the three States are brought together. The ditches in Colorado have been decreed absolutely the quantities given in the table. The volumes given for Wyoming and Nebraska are the maximum quantities to which the lands in these States are entitled, on the basis of 1 cubic foot per second to 70 acres:

Rights to water from North Platte River and tributaries in Colorado, Wyoming, and Nebraska.

Year.	Colorado.	Wyoming.	Total Colorado and Wyoming.		Nebraska.	
			Rights acquired.	Sum to date.	Rights acquired.	Sum to date.
	Cubic feet per second	*Cubic feet per second*	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*	*Cubic feet per second.*
1868		1.54	1.54	1.54		
1869		1.57	1.57	3.11		
1870		.53	.53	3.64		
1871		32.71	32.71	36.35		
1872		1.97	1.97	38.32		
1873		7.01	7.01	45.33		
1874		20.06	20.06	65.39		
1875		27.01	27.01	92.40		
1876		60.17	60.17	152.57		
1877		33.07	33.07	185.64		
1878		76.99	76.99	262.63		
1879		87.04	87.04	349.67		
1880	34.84	51.75	86.59	436.26		
1881	53.73	146.20	199.93	636.19		
1882	84.68	145.05	229.73	865.92		
1883	83.56	839.40	922.96	1,788.88		
1884	84.44	413.60	498.04	2,286.92	156.16	156.16
1885	136.00	675.89	811.89	3,098.81		156.16
1886	99.00	390.19	489.19	3,588.00		156.16
1887	395.55	417.77	813.32	4,401.32	1,142.86	1,299.02
1888	571.62	390.27	961.89	5,363.21	211.43	1,510.45
1889	363.50	156.49	519.99	5,883.20	532.67	2,043.12
1890	306.13	221.09	527.22	6,410.42	285.06	2,328.18
1891	506.00	279.10	785.10	7,195.52	30.86	2,359.04
1892	11.40	78.80	90.20	7,285.72	275.37	2,634.41
1893	118.70	207.72	326.42	7,612.14	471.85	3,106.26
1894	121.67	295.07	416.74	8,028.88	4,386.65	7,492.91
1895	49.05	307.01	356.06	8,384.94	1,267.83	8,760.74
1896	57.00	216.04	273.04	8,657.98	361.55	9,122.29
1897	69.60	110.49	180.09	8,838.07	772.14	9,894.43
1898	113 55	174.45	288.00	9,126.07		9,894.43
1899	39.90	125.45	165.35	9,291.42	400.00	10,294.43
1900	127.50	59.48	186.98	9,478.40	289.64	10,584.07
1901	67.25	370.29	437.54	9,915.94		
1902		920.50	920.50	10,836.44		
1903		30.60	30.60	10,867.04		
1904		730.60	730.60	11,597.64		

The table shows that the earliest right in Colorado was acquired in 1880, the earliest right in Wyoming in 1868, and the earliest right in Nebraska in 1884. There are, in the upper States, rights prior to any in Nebraska acquired by appropriation, amounting to 1,788.88 cubic feet per second. The main question is, however, regarding rights immediately above and below the Wyoming-Nebraska State line. As between these the ditches in Nebraska were built prior to most of those in Wyoming, the largest rights in the lower section in Wyoming having been initiated in 1901 and since, subsequent to all of those in Nebraska.

In addition to the rights enumerated in the table for Nebraska, there are rights to water attaching to riparian lands. (See p. 85.) The earliest settlements along the North Platte in Nebraska, except in the immediate vicinity of the city of North Platte and a few isolated ranches, were made in 1883 and the years following. Prior to that year rights to 865.92 cubic feet per second had been acquired in Colorado and Wyoming. The railroad land grant extends up the South Platte, and the North Platte enters the limits of the grant in the neighborhood of Lewellen (see map, Pl. I), consequently there are no railroad lands west of that point. In the vicinity of Lewellen railroad lands were selected in 1902, and therefore have no riparian rights, under the decision that the law of 1889 abrogated the rule of riparian rights. Through Deuel County for a distance of about 40 miles the railroad lands were selected in 1886. These lands include alternate sections and probably comprise about one-half of the riparian lands. Prior to 1886 rights in the upper States amounting to 3,098.81 cubic feet per second had been acquired. For the next 20 miles east of Deuel County railroad lands were selected in 1890, and consequently have no riparian rights. For about 10 miles above the junction of the North and South Platte rivers the railroad lands were selected in 1874, and along the main stream east of the junction they were selected in the same year. Prior to 1874 rights to only 65.39 cubic feet per second had been acquired in Colorado and Wyoming. Throughout much of the distance between the State line and the city of Kearney on the main stream, below which are no irrigation ditches, much of the riparian land is swampy and therefore will make no demand on the stream. As with the South Platte, no estimate of the amount of water which can be claimed by riparian owners can be made, but in view of the fact that only a small part of the railroad lands were selected before 1886, and that a large part of them were selected after the passage of the law of 1889 abrogating riparian rights, and that settlement along the river began as late as 1883, prior to which many rights had accrued in Colorado and Wyoming, riparian rights on the North Platte may be considered of little importance from an interstate standpoint.

As has been previously pointed out, the use of the water along the North Platte in Colorado occurs chiefly in the flood season, when there is plenty of water throughout the course of the stream and natural conditions are such that this use can not be greatly enlarged. Throughout the greater part of the course of the stream in Wyoming there is practically no irrigation. The question of interstate rights between Wyoming and Nebraska, therefore, comes down to consideration of the rights of ditches immediately above the State line in Wyoming and those in Nebraska.

The rights in Wyoming along this section of the river are, for the most part, subsequent to those in Nebraska, and a large part of those given in the table have not vested, but depend upon the completion of works and the use of water in accordance with the permits issued by the State engineer. The largest outstanding permits on this section of the North Platte in Wyoming are those of the Whalan Falls Canal Company and the Fort Laramie Canal and Reservoir Company. The former has a permit to divert water for 20,000 acres, the work to be completed in 1906. Some work has been done on this system, and the State engineer has authority to extend the time for the completion of works, so that it may be some years before the rights of this company are settled. The Fort Laramie Company has a permit, dated 1904, to divert water for 36,107 acres, the work to be completed in 1912. These two companies have pending rights which may equal more than 800 cubic feet per second, 300 of which can not be finally settled until 1906, and 500 of which can not be settled until 1912.

The rights of the ditches in Nebraska, as given in the table, were not finally determined, but were conditioned upon the completion of the works as planned at the time of the adjudication. (See p. 41.) Very few of these ditches has been completed, and their rights as given in the table are therefore largely in excess of their needs. The most striking example of this is the case of the Farmers' Canal, which has the second right on the stream and was granted conditionally 1,142.86 cubic feet per second, dating 1887. A decision of the supreme court in The Farmers' Irrigation District *v.* Frank[a] (see p. 41) has made this right absolute, except that it may be lost by abandonment. Not more than 2,000 acres have been irrigated by this ditch, and if its rights were cut down to the volume which has been beneficially used they would not exceed 30 cubic feet per second. The Gering ditch, which heads immediately below the State line, was given a conditional right to 500 cubic feet per second, while its maximum diversion in 1903 was 287 cubic feet per second, showing that its right, as given in the table, is nearly double the amount of water to which it can lay claim on the ground of use. But the use of water under this canal is being extended all the time, and it is probable that the right to the full volume can not be attacked on the ground of abandonment.

In both States the full volumes of the rights ultimately acquired by these companies will date from the filing of the applications, or the beginning of work where no applications were filed. It has been shown (p. 24) that there is flowing in the North Platte at times more water than is required to supply all outstanding rights, but as a matter of fact it is seldom that there is not more than enough water to supply all existing demands. Plans are being made for the construction of new works to utilize this surplus by private parties and the Federal Government. But there is no way of telling from the present flow of the stream and present diversions what supply of water these new canals will receive. The enlargement of use under existing and pending rights may absorb all the surplus except in extreme floods.

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[a] 100 N. W., 286.

A series of measurements of the North Platte and main Platte rivers, between the Colorado-Wyoming State line and the city of Kearney, Nebr., was made in the fall of 1903 by the agents of this Office to determine, so far as can be determined by a single series of measurements, the effect of diversions in the upper sections of the stream upon its flow farther down. These measurements are given in the following table:

Return seepage, North Platte River.

Section.	Length.	Gain (+) or loss (−).	Total gain (+) or loss (−) from upper station.
	Miles.	*Cubic feet per second.*	*Cubic feet per second.*
Colorado-Wyoming line to Douglas Creek	8.00	− 43.32	− 43.32
Douglas Creek to Sage Creek	52.00	−165.72	−209.04
Sage Creek to Fort Steele	22.00	− 41.12	−250.16
Fort Steele to Dickinson's ranch	21.00	+ 6.74	−243.42
Dickinson's ranch to Medicine Bow River	11.00	− 28.75	−−272.17
Medicine Bow River to Sweetwater River	33.00	+ 9.58	−262.59
Sweetwater River to Alcova	12.00	+ 3.18	−269.41
Alcova to Delaware Springs	21.00	− 17.25	−276.66
Delaware Springs to Muddy Creek	36.00	+ 70.85	−205.81
Muddy Creek to Douglas	40.00	− 43.81	−249.62
Douglas to Horseshoe Creek	43.00	− 7.89	−257.51
Horseshoe Creek to Guernsey Canyon	16.00	+ 55.01	−202.50
Guernsey Canyon to Whalen	14.00	+ 7.37	−195.13
Whalen to Fort Laramie	6.00	− 10.48	−205.61
Fort Laramie to Rawhide Creek	9.00	+ 77.28	−128.33
Rawhide Creek to Torrington	8.00	−− 76.90	−205.23
Torrington to Wyoming-Nebraska State line	12.00	+120.13	− 85.10
State line to Mitchell	14.00	+ 68.04	+ 68.04
Mitchell to Gering	10.50	+130.51	+198.55
Gering to Bayard	18.50	− 24.18	+174.37
Bayard to Bridgeport	13.30	+113.80	+288.17
Bridgeport to Oshkosh	45.50	− 69.47	+218.70
Oshkosh to Hayland Canal	30.00	− 51.20	+167.50
Hayland Canal to Paxton Bridge	24.00	+235.38	+402.88
Paxton Bridge to North Platte	34.00	− 22.35	+380.53
North Platte to Gothenburg	36.50	+109.76	+490.29
Gothenburg to Lexington	24.50	−164.79	+325.50
Lexington to Kearney	36.00	−209.62	+115.88

The course of the river throughout Wyoming is hard to follow, and the measurements were made at considerable intervals of time, leaving room for variations in the flow of the stream between the times of measurement. While the stream is more easily followed in Nebraska, Professor Stout, who made the measurements in that State, notes waves of increase and decrease during the progress of

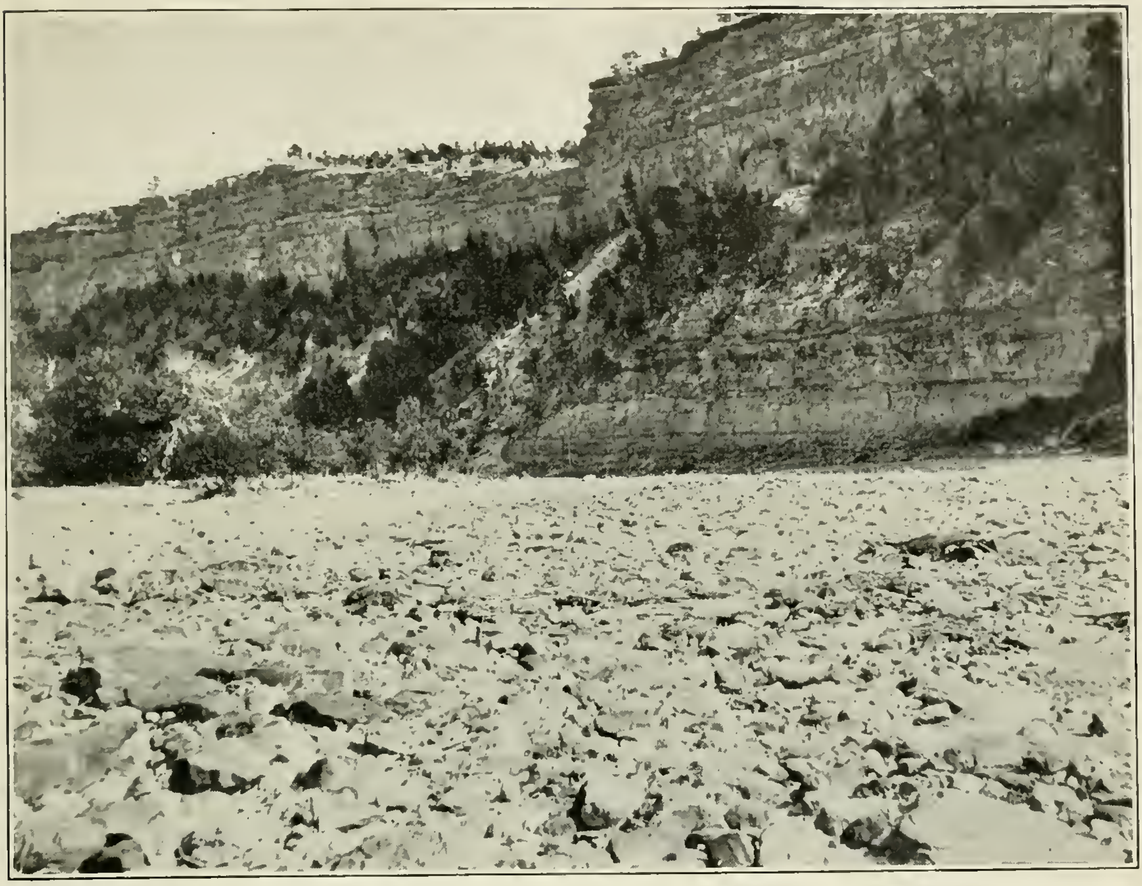

FIG. 1.—NORTH PLATTE RIVER AT GUERNSEY CANYON—LOW WATER.

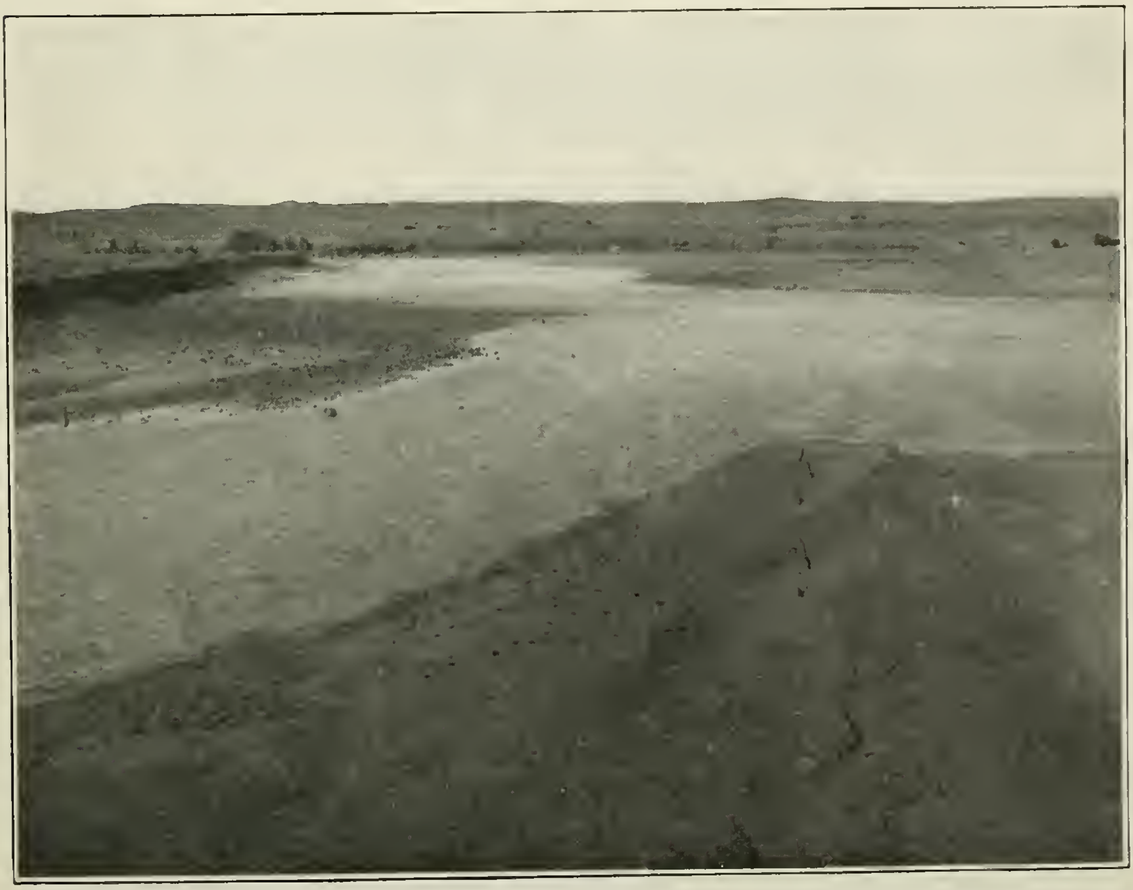

FIG. 2.—NORTH PLATTE RIVER NEAR DOUGLAS, SHOWING CHARACTER OF STREAM BED.

measurements, and attributes many of the changes to such waves rather than to return seepage. These waves are attributed to local precipitation, cloudy weather, which checks evaporation, or clear, windy weather, which greatly increases evaporation. The men making the measurements may overtake such waves or be overtaken by them in such a way that it is impossible to get any check upon their influence. It will be noted that throughout the entire portion of the stream measured there are alternating gains and losses in the flow. This may be attributed partly to the waves of increase and decrease mentioned above and partly to changes in the channel. The stream in some sections flows over solid rock, in others over beds of bowlders (Pl. IV, fig. 1), and in other sections winds back and forth over beds of deep sand (Pl. IV, fig. 2). Under such conditions varying portions of the water which is finding its way down the valley will be in the visible stream which is measured. The measurements should not, therefore, be given too much weight. Considering long sections of the river, the measurements through Wyoming show a net loss, while those between the Wyoming-Nebraska State line and Kearney show a net gain. It is not safe to base on these measurements any positive statements as to what would occur if conditions were different, but they seem to indicate that if ditches in Colorado or the upper sections of Wyoming were closed only a part of the water shut out of these ditches would reach Nebraska. Measurements in Nebraska seem to indicate that the closing of the ditches along the upper section of the stream within that State would increase the supply lower down as far as the vicinity of North Platte, below which there are large losses in the stream. The stream between North Platte and Kearney has from the earliest times gone dry in many years and been extremely low in every year, and it does not seem probable that the closing of the ditches above would noticeably increase the supply in the surface channel in this section of the river. The measurements of the water levels in wells, referred to on page 56, show that the water table for some distance north of the river has a slope to the south, which is not interrupted by the river, and indicate that water which passes into the sand in this section finds its way out of the valley of the Platte into the streams to the south. In the immediate vicinity of the Nebraska-Wyoming line there is a gain in the flow of the river, the notes of the measurements showing that in the section from Torrington to the State line the return seepage is almost exactly equal to the amount diverted in the section. There is prospect of large increase in the use of the water in this section immediately above the State line in Wyoming. The measurements seem to indicate that a large part of the water diverted in this section will return to the stream for use in Nebraska.

A large number of irrigators and ditch men in the vicinity of

North Platte and along the ditches below that city were interviewed, and none of them seemed to feel that diversions in the upper States diminished their supply of water. The general sentiment seemed to be that an increased use of water in Wyoming and along the upper valley in Nebraska would improve rather than injure the supply for the ditches below. The supply for these ditches has always been short in the late summer and could not be much worse. Their owners, therefore, look with favor upon the enlarged use of water above in flood season in the hope that the return seepage will maintain the flow below in the late summer.

From the above discussion it will be seen that there is little likelihood of any interstate conflicts on the North Platte unless it should be between ditches heading close together immediately above and below the State line. At present the Mitchell ditch heads just above the State line in Wyoming and carries water for use in Nebraska. The owners of this ditch have neither made an application nor filed a claim in either State. The Farmers' Canal and the Gering ditch head just below the State line, and surveys are being made for canals to head in the section above the State line. Contests have arisen between the Mitchell ditch and the other ditches, but the Mitchell ditch has so far been beyond control, since the Wyoming officials had no reason to close it to satisfy Nebraska ditches, and the Nebraska officials had no authority to close head gates in Wyoming. Some provision must in the future be made for controlling these head gates. Wyoming ditches above this point have no reason to complain, since they get the first chance at the water. All complaints will, therefore, come from Nebraska ditch owners, and the question is how to protect rights acquired in Nebraska against diversions in Wyoming.

It will be recalled that, regarding the South Platte, the conclusion was reached that the only probable conflicts would be between ditches immediately above and below the Colorado-Nebraska line.

INTERSTATE QUESTIONS.

The relations between rights on the same stream in adjoining States, or rather the interdependence of those rights, are not well defined. There is no legislation on this subject, either State or national, and few court decisions. In the State courts of Colorado but one decision even approaching this question has been rendered, and in that one decision[a] the court merely held that under the Colorado statute providing for the adjudication of water rights the district court was not authorized to determine rights to water to be diverted in Colorado for use in New Mexico. One of the ditches appearing in the adjudication has its point of diversion in Colorado, but extends beyond the boundary line and covers land in both Colorado and New Mexico. In the adjudication the ditch was denied any right for the land in New Mexico. The supreme court affirmed the decision on the ground that the lower court, under the special statute, had no jurisdiction to award any right for land outside the State. The court expressly disclaimed any consideration of the question whether the right for land in New Mexico would be protected in another action in the Colorado courts against subsequent appropriators in Colorado.

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[a] Lamson *v.* Vailes, 27 Colo., 201.

The question of the relation of rights on interstate streams was before the supreme court of Nebraska in Cline *v.* Stock.[a] Irrigation ditches in Nebraska had so used up the waters of the Republican River as to seriously interfere with its use for power by a Kansas mill owner who had used the water for power long prior to the construction of the irrigation ditches. It was contended by the defendants that the suit was an attack upon the sovereignty of Nebraska, and that the Kansas mill owner, being an appropriator outside the State, had no rights on the stream which the legislature of Nebraska must respect or might not authorize Nebraska citizens to disregard. In deciding against this contention the supreme court said:

> It would seem that the fact of the plaintiff's residence beyond the border of this State, and that his mill is located there, ought not to deprive him of any rights within the laws of our State given to a lower appropriator. Any attempt of our legislature to discriminate against him as compared with resident mill owners would be promptly declared unconstitutional by the Federal courts. It seems plain that the plaintiffs should be allowed the same standing as one of our own citizens with the mill on this side of the State line.

The same question has been considered by the supreme courts of Wyoming and Utah and by the United States courts for the district of Montana and Colorado. The Wyoming court held, in Willey *v.* Decker:[b]

> Under whatever system the right to appropriate water for irrigation is recognized, the natural and logical result of the doctrine would seem to be, at least in the case of interstate streams, and in the absence of contrary constitutional and statutory provisions, that the separation of the lands capable of irrigation from such streams by State lines is of no consequence if we are to consider merely the general principles of the doctrine and the reasons that called it into existence. The same necessity applies to the lands on either side of the line, and the water naturally flows in the channel of the stream in disregard of such line above as well as below it.

The Utah supreme court, in Conant *v.* Deep Creek Irrigation Company,[c] held:

> It is a recognized rule of law that a person who has appropriated water to a certain point in a stream is entitled to have so much of the waters of said stream as he has appropriated flow down to him to the point of his diversion,

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[a] 98 N. W., 454.
[b] 73 Pac., 210.
[c] 66 Pac., 188.

and if the settlers higher up on the stream in another State, whose appropriations are subsequent, divert any of the waters of the stream which have been so first appropriated, then the courts of the latter State will protect the first settler in his rights.

The United States court for the district of Montana, in Howell *v.* Johnson,[a] held:

> Appropriators of water from interstate streams are entitled to protection against injury by later appropriators, in accordance with the doctrine of prior appropriation, regardless of State lines.

The same principle is announced by the United States court for the district of Colorado, in Hoge *v.* Eaton,[b] in which the court held:

> The right to divert running waters for irrigating lands in an arid country is not controlled or affected by political divisions. It is the same in all States through which the stream so diverted may pass.
>
> An appropriation of water in the State of Wyoming from a stream which rises in Colorado for irrigating lands in Wyoming is valid as against a subsequent appropriation in Colorado from the same stream for irrigating lands in Colorado.

There are, so far as the writer has been able to find, no decisions denying the rights of appropriators in the lower State protection against injury by later appropriators in the upper State, while the decisions quoted above are all in favor of such protection.

The supreme court of Colorado has held repeatedly that the right to divert water from the streams of that State arises from necessity, not from the statutes of the State, and would still exist if the statutes were repealed.[c]

The supreme court of Nebraska, in Crawford *v.* Hathaway,[d] is committed to this same doctrine as regards the right in Nebraska.

> In our view of the subject, rights of appropriators of water, who have applied the same to the soil for agricultural purposes by means of irrigating canals, antedates the passage of either of the irrigation acts of the legislature of which we have just made mention. This right has grown out of the necessities of the case, and has been sanctioned by the acts of Congress and recognized by the laws of the State.

Other States are also committed to the same doctrine as to the origin of the right of appropriation. The Wyoming court, in Moyer *v.* Preston,[e] says:

> Irrigation and reclamation can not be accomplished with any degree of success or permanency without the right to divert and appropriate water of the natural streams for that purpose and the security accorded to that right. The imperative and growing necessity of our condition in this respect alone * * * compel the recognition rather than the adoption of the law of prior appropriation.

It is thus seen that the generally accepted doctrine in the three States through which the Platte rivers flow is that rights are based on the necessities of using water and not on their statutes. The necessity exists regardless of State lines, and therefore the rights should be protected regardless of State lines.

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[a] 89 Fed., 556.

[b] 135 Fed., 411.

[c] Yunkers *v.* Nichols, 1 Colo., 570.

[d] 93 N. W., 781.

[e] 44 Pac., 845.

PROTECTION OF RIGHTS IN A LOWER STATE AGAINST DIVERSIONS IN AN UPPER STATE.

In the case of Cline *v.* Stock, cited above, it was contended by the Nebraska ditch owners that the suit was an attack upon the sovereignty of Nebraska, and that the Kansas mill owner, being an appropriator outside the State, had no rights in the stream which the legislature of Nebraska must respect or might not authorize Nebraska citizens to disregard. The supreme court decided against this contention. The case was remanded to the lower court for a determination of the rights. In this case the Nebraska court declares that the rights of an appropriator in the lower State must be protected by the courts of Nebraska.

The same question is treated exhaustively by the supreme court of Wyoming in the case of Willey *v.* Decker.[a] In that case the Wyoming court, after declaring that rights by appropriation are good regardless of State lines, proceeds to consider the remedies which are available to the appropriator in the lower State. The stream in question rises in Montana and flows into Wyoming, but one of the ditches in contention diverts water in Wyoming for supplying lands in both Wyoming and Montana. In the one case, therefore, the question of the power of Wyoming courts to protect rights in Wyoming against diversions in Montana and rights in Montana against diversions in Wyoming is presented. On the question of the jurisdiction of the Wyoming courts to protect appropriators in Wyoming against diversions in Montana, after citing a long list of authorities, the court says:

> On principle and authority, therefore, we think there can be no doubt of the jurisdiction of the district court [Sheridan County, Wyo.] to render a decree restraining defendants Demmon from diverting the waters of the stream in Montana to such an extent as to deprive those plaintiffs whose lands are situated in this State [Wyoming] of the water to which they are found to be entitled by priority of appropriation.

As to the question of the power of the Wyoming court to protect appropriators in Montana against diversions in Wyoming, the court says:

> The rights of plaintiffs Willey and Ellison (whose lands are located in Montana), therefore, if they be found entitled by priority of appropriation, upon the facts, to the use of water as against any appropriation of defendants, include the right to have the water of the stream flow down to the head gate

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[a] 73 Pac., 210.

> of the ditch. An injury occurs to their rights if that flow be prevented. It follows that they suffer an injury within this State through the diversion of defendants at points above the head gates of Gladewater ditch.[a]

As regards the distribution of the North Platte River between ditches in Wyoming and Nebraska, therefore, the above citations show that both States are committed to the doctrine that an appropriator in the lower State may secure protection against diversions in the upper State in the courts of the upper State, while the Wyoming court holds that diversions in the upper State can be restrained by the courts of the lower State.

The same doctrine as to the courts of the upper State has been announced by the supreme court of Utah in the case of Conant *v.* Deep Creek and Curlew Valley Irrigation Company,[b] and the district court of Idaho assumed jurisdiction over an interstate stream in the case referred to in the Utah case just cited. In this case the Utah court says:

> It is a recognized rule of law that a person who has appropriated water at a certain point in a stream is entitled to have so much of the waters of the said stream as he has appropriated flow down to him to the point of his diversion, and if the settlers higher up on the stream in another State whose appropriations are subsequent, divert any of the waters of the stream which have been so appropriated then the courts of the latter State will protect the first settler in his rights. The Idaho courts, therefore, have ample and complete jurisdiction to protect the rights of respondents to have the waters which they have appropriated and which they divert in Utah flow through the channel of the stream and to limit and determine the rights of the Idaho appropriators with reference thereto; and by the decree entered in the suit in the district court of Oneida County, Idaho, such rights were fully protected and may be enforced by proper proceedings in that court.

It has been contended that an appropriator would not receive justice in the courts of another State, but it will be noted that in each of the decisions quoted, except the Utah case, the decision was rendered in the State whose citizens would be deprived of water by the enforcement of the decision.

In the case of Hodge *v.* Eaton[c] the Federal district court granted an injunction restraining diversions from Sand Creek in Colorado to the injury of prior appropriators in Wyoming.

Each of the States through which the Platte River flows has recognized, however, that an appeal to the courts every time a ditch owner does not receive what he considers his proper supply of water is an expensive remedy. Referring to the disadvantages of leaving such matters entirely to the courts, the Wyoming court in Willey *v.* Decker[a] says:

> It is evident, however, that one irrigating lands in another State must suffer some disadvantages. The State laws regulating the distribution of water can

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[a] 73 Pac., 210.

[b] 66 Pac., 188.

[c] 135 Fed., 411.

not operate beyond its boundaries, and it is doubtful whether any remedy in case of injury to his rights is open to such an appropriator other than those obtainable through the medium of the courts.

To avoid such litigation within its own limits each of these States has provided an administrative system, with officials to distribute water to the ditch owners according to their rights as determined by the courts or the boards of the States.

If the flow of a stream were constant a ditch in an upper State might be permanently closed by injunction, and the single suit would serve to protect the rights of the lower appropriator; but the flow of the stream varies from day to day, so that the diversion by the upper ditch might one day injure a lower appropriator and another day leave sufficient water in the stream to satisfy his rights, and his right is only to have a certain volume of water flow down to him. Under such circumstances, in the absence of any official whose duty it is to regulate head gates, it would be necessary for the lower appropriator to resort to the court every time his right was infringed, and a multiplicity of suits would result. Therefore, protection of the rights of the lower appropriator in the courts of the upper State, while adequate, is not satisfactory, and there is need for some system similar to the administrative systems adopted by each of the three States, Colorado, Wyoming, and Nebraska. In Colorado the common practice is for the superintendent of a water division to order the commissioner of an upper district to close the ditches whose rights are later than those in a lower district which are not receiving their full supply. This entails no expense, and the only formality required is to notify the superintendent of the shortage of water in the lower district. Under a similar system with interstate powers, the official having general charge of the distribution of water would have a complete table of priorities for the several States, and when notified by the lower ditch owners that they were not receiving their full supply of water would order closed later ditches in the upper State. This can be provided for in several ways. It has been proposed that the General Government appoint, under proper legislation, an interstate irrigation commission, to which all interstate questions shall be referred. This proposed commission is not to supersede State officials, but to issue orders to the State engineers to turn down interstate streams the water which belongs to parties in a lower State, just as in Colorado a division engineer orders the water commissioner of one district to turn water down to a lower district. It is also proposed that a similar commission be provided for by compact between the interested States.

WATER-RIGHT SYSTEMS.

In the preceding discussion the nature of water rights has been discussed only in a limited way, and the attempt has been to show what rights exist in the different States and to define their relation to each other. It seems desirable to go further and discuss the general subject of water rights in the Platte watershed in their relation to social conditions and the best use of the water supply. Preliminary to this discussion is a statement of the nature of the rights in the three States as defined by legislation and court decrees.

COLORADO.

The first Territorial legislature of Colorado provided for the acquirement of water rights by appropriation, and the Territorial supreme court declared that the right existed prior to legislation on the subject.[a] The right of appropriation, therefore, is not based on legislation, but on natural conditions. The constitution of the State carries this same idea, by not providing for the acquirement of rights by appropriation, but stating that "the right to divert the unappropriated waters of any natural stream for beneficial uses shall never be denied."

The right of appropriation is therefore a natural right, which the people of the State, in the adoption of their constitution, recognized but did not create. This position is further borne out by decisions of the supreme court of the State,[b] in which the court held that the legislation of the State on this subject was in exercise of its police power.

The nature of the legislation of the State shows the same thing. It is confined to providing the procedure for defining rights—not granting them—and the procedure and officials for enforcing and protecting rights.

The laws of the State recognize no riparian rights and the supreme court of the State has held that the doctrine of riparian rights has no application to Colorado streams, because of natural conditions, which require that the water of streams be diverted.[c]

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[a] The right to water in this country by priority of appropriation thereof we think it is and always has been the duty of the National and State governments to protect. The right itself, and the obligation to protect it, existed prior to legislation on the subject. (Coffin *v.* Left Hand Ditch Company, 6 Colo., 443.)

[b] This court held that our so-called irrigation statutes for the ascertainment of priorities, and placing the distribution of water for irrigation purposes under control of State offices, are constitutional, though they affect rights which accrued before the enactments were made and place upon their enjoyment limitations from which they were theretofore exempt. These statutes are upheld as a rightful exercise of the police power of the State. (New Cache la Poudre Irrigation Company *v.* Water Supply and Storage Company, 29 Colo., 469.)

[c] Oppenlander *v.* Left Hand Ditch Company, 18 Colo., 142.

Since the right to appropriate water grew out of climatic conditions rather than legislation, the nature of the rights acquired and the limitations upon them were not well defined, and the constitution and laws of the State have left them largely undefined. Consequently the courts of the State have been free to limit rights as they saw fit, and court decisions must be looked to for the nature of water rights. The most far-reaching ruling regarding water rights in Colorado is that they may be sold and transferred independently of the land on which the water has been used.[a]

That is, it is not a right to enough water for a described area of land, but a right to a definite volume of water, which may be sold and transferred to any land that can be reached, provided no one is injured by the transfer. Until 1901 no procedure for making transfers was prescribed, and parties claiming to be injured were obliged to bring suit to prevent the transfer. In 1903 a law was enacted providing that parties wishing to change the place of diversion or use of water must apply to the court for permission to make the change. On such application being made a hearing similar to an adjudication is held, and all parties interested may be heard for or against the transfer, and it can be made only on approval by the court after such a hearing.

Without exception the decrees in the districts including the South Platte and its tributaries confirm to the various ditches rights to definite volumes based, in some instances, on the measured or estimated capacities of the ditches, in others on the statements of the interested parties as to what they had used, and in others computed from the area said to have been irrigated. These rights are held to be absolute even if the computations made in compiling the decree are shown to have been wrong.[b] The right is to a continuous flow of the volume stated.

Although an adjudicated right can not be questioned after the expiration of the statutory period for appeal, it may be lost by abandonment. If a party does not make use of the volumes of water decreed the right will be open to attack on this ground and may then be cut down to the volume which has been put to beneficial use.

WYOMING.

Wyoming was organized as a Territory in 1868. Prior to this there was almost no settlement and practically no agriculture. The first legislature adopted the common law of England so far as it was "not inapplicable." The supreme court of the State has held that this enactment did not establish the doctrine of riparian rights in Wyoming, as that doctrine is considered inapplicable.[a]

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[a] A priority of right to the use of water for irrigation is a property right, and may be sold and transferred separately from the land in connection with which it ripened. (Strickler *v.* Colorado Springs, 26 Pac., 313.)

[b] Boulder and Weld Ditch Company *v.* Lower Boulder Ditch Company, 22 Colo., 115.

With the admission of Wyoming as a State, in 1890, an entirely new code of water laws was adopted. The constitution declared that all unappropriated water was the property of the State, and that rights to its use could be acquired by appropriation. Laws were enacted which limited the right of appropriation and required any party wishing to divert water to make application to the State engineer and receive a permit before construction began. This permit is not a deed to water, but merely gives the applicant the right to proceed with the construction of works and the diversion of water in accordance with the terms of the permit.

None of the Territorial laws regarding water rights defined them in any way. Under these laws there was no litigation and consequently no court decisions setting forth the nature of rights to water. The law of 1886 required the filing of statements giving the date of construction, capacity of works, amount of the water claimed to be appropriated, the number of acres "lying under and being or proposed to be irrigated" by the works. The law contains nothing which would give any indication as to which of these conditions was to govern the volume of the right. Only a few adjudications took place under the law of 1886. The first of these was to determine the rights on Bear Creek. The decree awarded definite quantities of water to the parties to the adjudication, only a few of those using water from the stream appearing. The court in this case apparently considered that the parties had rights to definite quantities of water. The decree defining rights to Crow Creek awarded to each party sufficient water for a definite area of land, not to exceed a fixed volume. No uniform rule was observed in fixing this maximum volume which could be used and no ditches were named. The rights would therefore seem to have been considered as not attached to any particular areas, but they did not entitle their holders to fixed quantities of water, but rather to sufficient water for definite areas of land. The decree defining the rights to Horse Creek is similar to that on Crow Creek, except that the ditches are named. This would not, however, change the nature of the right.

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[a] The common-law doctrine relating to the rights of a riparian proprietor in the water of a natural stream and the use thereof is unsuited to our requirements and necessities and never obtained in Wyoming. * * * A different principle, better adapted to the material conditions of this region, has been recognized. The principle, briefly stated, is that the right to the use of water for beneficial purposes depends upon a prior appropriation. We incline strongly to the view expressed by the supreme court of Colorado to the effect that such right and the obligation to protect it existed anterior to any legislation on the subject. (Moyer *v.* Preston, 6 Wyo., 308.)

The same principle, that is, that the appropriator is entitled to enough water for a specified area, is contained in the law adopted in 1890. There is, however, the limitation that this use shall not exceed 1 cubic foot per second for 70 acres. The board of control has uniformly held that the rights acquired since 1890 are attached to particular tracts of land. This ruling has, however, been reversed by the supreme court of the State in the recent case of Johnston *v.* Little Horse Creek Irrigating Company.[a] A ditch company which had been awarded a right by the board of control sold a half interest in the right awarded to it, and a third party, whose rights were later than those of the seller but acquired prior to the sale, attacked the transfer on the ground that under the laws of Wyoming a water right is attached to the land and can not be transferred apart from the land. Regarding this contention the court says:

> We are aware that notwithstanding the expressions and decisions in the cases above mentioned, which decisions were rendered in 1894, prior to the execution of the deed in question, there has existed in the minds of the administrative officers of the State charged with the execution of the laws governing the appropriation and distribution of water an opinion that, by reason of some provisions of our statutes, unlike the statutory provisions prevailing in most of the other arid States, water appropriated for the irrigation of land becomes not only appurtenant thereto, but inseparably connected therewith, and therefore incapable of transfer or conveyance separate from the land; and the opinion, we understand, has prevailed among such officers that in the cases aforesaid the effect of our peculiar statutory provisions was not considered. In view of the fact that such decisions were rendered before the conveyance in question, and that the parties presumably relied thereon in granting and receiving the conveyance, the law ought to be found very clear to justify the court at this time in overruling them and holding the transfer void.
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> It is not denied, nor can it be, that it has uniformly been held in this country, wherever the doctrine of prior appropriation is recognized, that a water right obtained by and for the irrigation of land may be sold separate therefrom. (Gould on Waters, sec. 234; Kinney on Irr., secs. 264, 265, and cases cited; Long on Irr., sec. 79; 3 Farnham on Water and Water Rights, secs. 643, 679.) Mr. Farnham says, in section 679 of his work, above cited: "The right acquired by an appropriation of water being a property right, it is subject to transfer the same as any other species of property; and this transfer may be separate from the land upon which it was intended to be used. And this sale may include all of the right to which the vendor is entitled, or it may be limited to a portion of it." And in section 643 the same author says: "But there is no reason why it should remain attached to the land in connection with which it was first used, and therefore the rule is that it may be sold separate from the land."
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> As an appropriator of water obtains by his appropriation that only of which he makes a beneficial use, it necessarily follows that he can not sell surplus water which he does not need, while retaining his original appropriation, and

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[a] 79 Pac., 22.

it has been held that, as against a subsequent appropriator, a senior appropriator can not give the water he does not use to another for a certain period, who otherwise would have no right to use it. (Manning *v.* Fife (Utah), 54 Pac., 113.) So far as we are informed, however, every case in which that or a similar principle has been decided admits that the water right may be sold and conveyed separate from the land, provided other appropriators are not injuriously affected by such sale.

An individual appropriator of water for irrigation secures no surplus water; hence he has no surplus which he can either sell or give to another, as against subsequent appropriations. His appropriation, and therefore his water right dependent thereon, is at all times limited, within the maximum of his appropriation, to the quantity capable of beneficial use and actually so used. If during any period he does not require the use of the water, it falls during that period to the subsequent appropriator who does need the same and can beneficially use it. What the appropriator may sell is his water right. That is all he has to sell. That is all that would pass by deed of the land as an appurtenance. The water in the stream is not his property, but his right to use that water, based upon his prior appropriation for beneficial purposes, is a property right, and, as such, is capable of transfer. The only limitation upon the right of sale of a water right separate from the land to which it was first applied, and to which it has become appurtenant, laid down by any of the authorities, is that it shall not injuriously affect the rights of other appropriators. In other words, the burden upon the use must not be enlarged beyond that which rested upon it under the original appropriation, and while in the hands of the original appropriator as he was entitled to and did use it. This principle is the necessary result of the fact that the only property in the water owned by the appropriator is a right to use it as measured by his appropriation.

NEBRASKA.

The Territory of Nebraska adopted "so much of the common law of England as is applicable and not inconsistent with the Constitution of the United States, with the organic law of this Territory, or with any law passed or to be passed by the legislature." This left the question as to whether the Territory adopted the common-law rule as to riparian rights unsettled and depending on the applicability of the rule. This question was not finally decided until the rendering of the decree in Crawford Company *v.* Hathaway[a] in 1903. The court held that the rule was adopted and remained in force until abrogated by statute.

The first legislation of the State referring to irrigation was the act of 1877, which extended to irrigation canals the provisions of the laws relating to internal improvements. This empowered canal companies to issue bonds and condemn rights of way for canals. It made no mention of the right to take water from streams to fill these canals, and the court held that this law did not abrogate the rule as to riparian rights. Consequently, whatever rights were acquired rested on custom rather than legislation and were subject to riparian rights previously acquired.

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[a] 93 N. W., 791.

Under the act of Congress of 1866, recognizing rights acquired by appropriations made in accordance with local laws, customs, or decisions, and making all public land thereafter disposed of subject to such rights, rights acquired by appropriation in Nebraska are held to be superior to riparian rights attaching to lands acquired from the Government after the appropriations were made.

No further irrigation legislation was enacted until 1889. In that year a law was enacted providing that rights to water from the streams, etc., of the State might be acquired by appropriation, priority giving the better rights as between appropriators. The water must be taken for a beneficial use, and when the use ceases the right ceases. Parties who had made diversions prior to the passage of this law were held to have acquired rights to water equal to the capacities of their ditches, but in no case exceeding the quantity claimed. This law is held to have abrogated the common-law rule, and lands acquired from the United States Government since its passage have no riparian rights. In regard to rights acquired by appropriation and by the ownership of riparian lands prior to the enactment of the law of 1889, the court says:

> The two doctrines stand side by side. They do not necessarily overthrow each other, but one supplements the other. The riparian owner acquires title to his usufructuary interest in the water when he appropriates the land to which it is an incident, and when the right is once vested it can not be divested, except by some established rule of law. The appropriator acquires title by apropriation and application to some beneficial use and of which he can not be deprived, except in some of the modes prescribed by law. The time when either right accrues must determine the superiority of title as between conflicting claimants. (Crawford Company *v.* Hathaway, 93 N. W., 791.)

That is, a right acquired by appropriation prior to 1889 is subject to the rights of riparian lands acquired from the Government prior to the appropriations, and riparian rights are subject to all rights acquired by appropriation made prior to the acquirement of the lands from the Government. Rights obtained by appropriation since 1889 are subject to the riparian rights attaching to lands acquired from the Government prior to that year. The nature and limitations of the water rights of riparian proprietors are fully brought out in the case cited. This decision is discussed by Mr. Dunton as follows:

> By the doctrine of Crawford *v.* Hathaway the rights of a riparian owner, to which he acquires title when he secures the land on the banks of a stream, consist in the right to use the waters of the stream for domestic purposes, such as drinking and cooking and watering stock, and also in the right to a reasonable use of such waters for purposes of irrigation. "This right of a riparian owner as such to the use of water for irrigation is limited to riparian lands. The right can not be extended to lands contiguous to the riparian land, nor can water be diverted to nonriparian lands which might be used on riparian lands, but is not. Land to be riparian must have the stream flowing over

it or along its borders." Its extent can not in any event exceed the area acquired by a single entry or purchase from the Government, and the court was strongly inclined to hold that such area should be restricted to the smallest subdivision of a section—that is, 40 acres—or, in case of irregular tracts, a designated, numbered lot in the Government survey, bordering on the stream. "This is not to be taken, however, as meaning that every riparian owner may claim the benefit of the stream for the purposes of a tract of that size in every case. It is to be taken as a limitation of the reasonable use permitted by law rather than as defining it. In case the size of the stream, the amount of water therein, and the number of riparian owners who may make use thereof are such that the irrigation of 5 acres, for example, would be an unreasonable use, the riparian owner would not be permitted to use water to that extent in derogation of rights of other riparian owners, and in consequence could not claim damages against an appropriator on that basis. (McCook Irrigation and Water Power Company *v.* Crews, 97 N. W.)

For infringement upon his rights the riparian owner can not enjoin an irrigation enterprise by an upper appropriator, nor can he do so even though his damages for injury to his riparian rights have not been paid. His only remedy is to sue the irrigator for damages. The mere fact that he is deprived of the full flow of the stream adjacent to his land would furnish no basis for such damages. "Merely diminishing the volume of water in the stream would not deprive the owner of property for which he could lay claim to a pecuniary compensation." In order to entitle him to compensation he must suffer an actual loss or injury to his riparian rights as above defined, which will materially depreciate the value of the land to which such rights are attached.

One phase of the question of riparian rights was considered, but not decided, in Crawford *v.* Hathaway, which is of especial importance in considering the Platte rivers. The court states that "as to those streams of water flowing through the State which may be classed as interstate rivers, and along the banks of which meander lines have been run by the Government in its survey of public lands, the question is left open as to whether or not the waters of such streams may not be treated as waters of navigable rivers and to which riparian rights of an adjoining landowner would not attach as against the right of the public to use the waters thereof by its appropriations and application to beneficial purposes." The Platte River is essentially an interstate river. Both it and its branches—the North Platte and the South Platte—are meandered streams, and should the further decisions of the court affirm the above doctrine, to which Chief Justice Holcomb seemed inclined, the question of riparian rights would be entirely removed from any controversies over water rights from the Plattes.

Regarding water rights acquired by appropriation and use prior to its passage, the law of 1889 provides that the owners of ditches should be held to have rights to the capacities of their works, but not exceeding the amounts claimed, and that the place of use might be changed if others were not injured by the change. Under this law, then, the water-right holder had a right to a fixed quantity, which was not attached to the land, since he could change the place of use and sell the water apart from the land or sell the surplus not needed for his own land. The only limitation was that it must be put to beneficial use and kept in use or the right would lapse.

Under the law of 1895 rights are acquired, as in Wyoming, by applying to the State board of irrigation, building a ditch, and using water, and the holder has a right to sufficient water to irrigate his land, not to exceed 1 cubic foot per second for 70 acres. This right attaches to the land for which the application was made and approved by the board, and the water can be used on no other land. The right, therefore, belongs to the land, not to the individual, and can not be disposed of apart from the land. The right is to sufficient water for the particular tract, within the limit of 1 cubic foot per second for 70 acres, and not to a fixed quantity. If the full quantity is not needed for this land it remains in the stream and goes to supply later rights, instead of being sold by the holder of the earlier right.

From the foregoing statement it appears that in each of the States in which the Platte rivers extend rights have been acquired by appropriation; that water must be put to a beneficial use; that among appropriators the first in time is the first in right; and that in Colorado and Wyoming rights may be transferred from one tract of land to another, if others are not injured by the transfer.

ACQUIREMENT OF RIGHTS BY APPROPRIATION.

The right to appropriate water from streams is usually considered in its opposition to the common-law doctrine of riparian rights. But the doctrine of riparian rights is so manifestly unsuited to the conditions of the arid region and the diversion of water from streams is so essential to any considerable development of that region that it is not considered necessary to discuss appropriation in that light. Assuming that the water must be diverted from the streams in order that the country may be developed, and that its diversion is, therefore, justifiable, two systems of acquiring rights are possible--appropriation and grant or license.

A system of grant or license requires that the water belong to the public, as it does, and that the State or nation allow its use only on the receipt of a grant from the authority controlling it. The most evident advantage of such a system is that there is always a complete record of rights and that rights will always be well defined, since they will be limited by the terms of the grants. On the other hand, the most evident disadvantage of a system of appropriation is that there is no complete record of rights and the nature and limitations of rights are not defined. This has been the greatest evil of this system in its operation in the arid section of the United States. Canals were built and water used without any record of what was done. This process went on until there was not water enough for all. The principle of priority was generally recognized, but there were no records to show whose rights were prior, and where this was well known there were no commonly accepted rules as to the limits of the rights of appropriators. Uncertainty as to these points has led to litigation, which has been the greatest burden on the water users of the West.

Various attempts, none of them successful, to provide for records of appropriations have been made. The most common is a requirement that the party desiring to appropriate water must post a notice of the intended appropriation at the proposed point of diversion and file a copy of this notice with some public official, the notice to state fully the intentions of the claimant. Colorado now has such a law, and Wyoming and Nebraska have had them in the past. Their weakness lies in the fact that there is no limit on what may be claimed, and no public inspection of the work done to see that the water claimed has been diverted and used. As a result there are hundreds of claims on file with no record whatever to show whether the appropriations were ever completed. The records are, therefore, valueless as showing what rights exist, and they do not, of course, show anything as to the nature or limitations of rights. It is possible to enact laws defining exactly the nature of rights and providing for inspection of claims filed and works built and the recording of the results of such inspection, which, if properly enforced, might do away with the evils which have so far attended the acquiring of rights by appropriation, but the experiment has never been tried.

Wyoming and Nebraska have, however, gone further than the course suggested and adopted what amounts to a system of license, although the word "appropriation" is still retained in their laws. Under these laws the intending water user must make application to the State engineer, stating what his plans are, and before construction may begin this application must be approved, and it may be rejected if its approval is contrary to the public interests. The approved applications state the time within which the works must be completed, and the laws provide for the submission of proof of completion and for inspection of the works by public officials. After such proof and inspection, certificates are issued defining exactly the rights which have been acquired. The Wyoming law was enacted in 1890 and the Nebraska law in 1895, and there has been little litigation regarding rights initiated since these laws went into effect.

TRANSFERS OF WATER RIGHTS.

Colorado has provided by law for transfers, with the restriction that others shall not be injured. The board of control in Wyoming has uniformly held that transfers could not be made, but has been overruled by the supreme court of the State,[a] while the Nebraska supreme court has followed the Wyoming board of control in holding that water rights can not be transferred. The most immediate effect of the ruling that transfers can be made in Wyoming was to destroy the value of the records of the State engineer's office as a guide for the distribution of water by the State officials, since there was no provision for recording transfers; but a law providing for such records was at once enacted.

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[a] Johnston *v.* Little Horse Creek Irrigation Company, 79 Pac., 22. See p. 83.

A careful distinction should be drawn between transfers of rights from one piece of land to another and transfers which permit the holding of rights apart from any land and the sale of the water obtained on such rights. Against transfers of the first class there is no objection if they are safeguarded by such restrictions and public supervision as will insure that there is no enlargement in the demand upon the supply to the detriment of other rights, and if the diversion of the water at the new point does not lessen the supply for others. For example, the transfer of a right from the lower end of a stream where it is supplied by return seepage to the upper end of the stream where the water diverted would come from the natural supply of the stream might mean the taking of water away from others to their injury, while a transfer from the upper to the lower end of a stream might result in a decreased demand on the stream on account of return seepage or an increased demand on account of losses rather than gains in the channel of the stream.

Against transfers which permit of the ownership of water rights apart from land the fundamental objection is that it makes possible a monopoly of the water supply, which may lead to extortion. To guard against this throughout the arid region the use of water in irrigation is declared to be a public use, making it subject to public control, and giving to the public the right to regulate rates. The constitution of Colorado provides that the rates which may be charged for water may be fixed by the county commissioners of the various counties. Wyoming had such a statute until 1903, and the supreme court of Nebraska has held that in that State the law may interpose to prevent the collection of unreasonable rates, although there is at present no statutory provision for such regulation.[a] There is, however, very little water sold or rented by ditch companies in the Platte valleys. In Colorado more than 85 per cent of the land watered by the Platte rivers is served by ditches owned either by the individual farmers using the water, by partnerships of such farmers, or by stock companies, the stock of which is principally in the hands of the farmers, notwithstanding the fact that irrigation has been practiced there for almost fifty years, and the right of transfer has always existed. In Colorado the present tendency is away from the ownership of ditches for the sale of water, and irrigation districts are being organized to buy out the ditches, and a bill providing that such districts might condemn the ditches watering the lands of the districts was introduced in the Nebraska legislature in 1905, but was not enacted.

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[a] Frank *v.* Farmers' Irrigation District, 100 N. W., 286.

Although there are few companies selling or renting water in the Platte valleys, there is an indeterminate amount of such traffic by individuals owning stock in ditch companies. The prevailing form of ditch company is the stock company, the stock entitling its holder to a share of whatever water the ditch furnishes. The stock of these companies may be bought and sold, and the water used on any land which can be reached by the ditches. The expenses of maintenance and operation are usually met by assessments on the stock, and the companies neither sell nor rent water, and consequently have no rates which can be regulated. The individual stockholders sell or rent their stock, and the rentals do not come within the provisions of the Colorado law. This practice is not uncommon, and in the North Platte Valley in Nebraska promoters of a sugar factory have secured control of several ditches by buying a majority of their stock. In Nebraska, however, stock ditch companies cover expenses by charging for water[a] rather than by assessments on stock, and it may be that these charges would be subject to regulation by law. If not, these promoters, owning a majority of the stock of the companies, can regulate charges to suit themselves. In fact, the claim that they can do this is used to bear the price of land to aid them in buying it up. To be effective, therefore, in preventing extortion, the laws relating to the fixing of rates must be extended to control rentals of ditch stock in Colorado and rates charged for water in Nebraska by companies originally organized to supply water to their stockholders, the stock of which has passed out of the hands of the water users.

BENEFICIAL USE.

Where rights to water are acquired by appropriation, the appropriation must be for beneficial use, and, logically, the rights are limited by the beneficial use made. Under the doctrine of priority the party having made a beneficial use of water is entitled to continue that use as against anyone having subsequently taken water from the same source. Abstract justice to the subsequent appropriator requires that the use of water by the prior appropriator be such as to maintain conditions as they were at the time the subsequent appropriation was made, in so far as any change in conditions would affect the continuation of the use to which the water had been put by the later appropriator. That is, the right of an appropriator at any time would be limited to the right to continue the beneficial use which he had made up to that time, and any enlarged use or different use would be later and therefore subject to any rights acquired by others in the meantime. This would be the logical result of basing rights absolutely on beneficial use, and this principle is at the foundation of water rights in the Platte Valley, although it is very much obscured by modifications adopted in applying it.

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[a] Enterprise Company *v.* Moffitt, 58 Nebr., 642.

It would be extremely difficult to make and enforce a table of priorities showing just when each enlargement in use by each appropriator took place. Under existing practice a single appropriator may have two or three or more rights with different priorities, but if each canal had a separate priority for each piece of land as it was brought under cultivation, and if for each piece of land there was a series of rights with different dates, as the character of the crops grown and therefore the time of use and quantity used changed the distribution of the water of a stream in accordance with those rights would be so intricate and burdensome that the water would be hardly worth the cost of distribution. This has been avoided by basing rights on original construction and subsequent enlargements of works. In Colorado the right is dated at the time of beginning construction, the measure of the right being the carrying capacity of the works, provided the water is put to a beneficial use within a reasonable time. In Wyoming and Nebraska the measure of the right is the need of the area of land for which an application is approved by the State engineer, and the time within which the water must be put to the beneficial use is fixed in the approval of the application. If the water is put to use within a reasonable time in Colorado, and within the prescribed time in the other States, the right to the whole volume dates from the first step in its acquirement. This is known as the right of relation, and is a modification of the principle of beneficial use, made necessary in putting that principle into practice.

The doctrine of relation has, however, a much more important bearing. It is necessary to the construction of large works, since without it there would be no assurance that when such works are completed there will be any water left in the source of supply. Other ditches begun later might be rushed to completion and the water all diverted, making whatever had been expended on the first ditch a total loss. Without this modification of the principle of beneficial use it is doubtful whether any large canals would be built. Canals are usually built to water land previously uninhabited; a company building a large canal can not get settlers for all its lands at once. This must necessarily be a slow process, taking in some cases many years. Theoretically, the application of the water to land is necessary to the acquirement of the right, and the question of what is reasonable diligence in securing settlers to make such application is hard to answer. The courts of Colorado have avoided it by ignoring it entirely (see pp. 26–36) and decreeing rights usually on the basis of the estimated capacities of the ditches or on the areas under the ditches, dating the right to the full amount on the date of construction, regardless of when the water was finally put to use or whether it has ever been used. In doing this the Colorado courts are, however, clearly within the law, since the statute providing for the adjudication of water rights directs the courts to—

> * * * make and cause to be entered a decree determining and establishing the several priorities of right, by appropriation of water, of the several ditches, canals, and reservoirs in such water district, concerning which testimony shall have been offered, each according to the time of its said construction and enlargements, or extensions, with the amount of water which shall be held to have been appropriated by such construction and enlargements, or extensions, describing such amount by cubic feet per second of time, if the evidence shall show sufficient data to ascertain such cubic feet, and if not, by width, depth, and grade, and such other descriptions as will most certainly and conveniently show the amount of water intended as the capacity of such ditch, canal, or reservoir, in such decree. (Mills Ann. Stat., sec. 2403.)

The courts of Colorado have repeatedly held that the application of the water to a beneficial use was necessary to the acquirement of a right,[a] and these decrees are, therefore, not final. The status of rights thus decreed is brought out by Justice Campbell, of the supreme court of Colorado, in two cases decided in 1895.[b] In the first case a ditch was awarded a right in excess of its use and did not after the decree use the surplus, but after several years attempted to transfer it. In the second case it was alleged that a ditch was awarded more water than it had used up to that time; but after the rendering of the decree had used the volume decreed. It was held that in the first case the decree, not being appealed from within the statutory period, was conclusive as to the rights of the ditch company, but its failure to put the volume of water decreed to it to a beneficial use within a reasonable time constituted an abandonment. In the second case, also, the decree was conclusive, but the water was immediately put to a beneficial use and the ditch had the right to the quantity decreed it, even if it had never used this volume prior to the rendering of the decree.

Under these decisions a decree becomes somewhat analogous to an approved application in Wyoming or Nebraska, with this difference: The approved application states the time within which the water must be put to a beneficial use, and the law provides for the submission of proof of the use of the water, while under the decree there is no such provision, but the burden of proof is on the adverse claimant, who must show abandonment. The Colorado adjudications look like an abandonment of the principle of beneficial use, but a more correct view of them is that they recognize the principle and go upon the theory that the construction of a ditch creates a presumption that the volume of water which it will carry has been put to a beneficial use.

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[a] "The diversion ripens into a valid appropriation only when the water is utilized by the consumer." (Platte Water Company *v.* Northern Colorado Irrigation Company, 12 Colo., 531.)

[b] New Mercer Ditch Company *v.* Armstrong, 40 Pac., 989; and Boulder and Weld County Ditch Company *v.* Lower Boulder Ditch Company, 43 Pac., 540.

This interpretation of the principle of beneficial use greatly simplifies the adjudication of rights and the distribution of water, but has been the cause of more trouble than any other one feature of the Colorado water law. Most of the adjudications of rights to the South Platte and its tributaries took place soon after 1880, and about the time that many of the large canals were constructed. Few, if any of them, were using their full capacities and no great care was exercised in determining ditch capacities, most of the decrees being based on estimates. (See pp. 26–36.) In this way it happened that most ditches were decreed larger volumes of water than they were using and many of them more than they could carry. The sum of all the rights decreed was for more than the stream supplied, but since few took or attempted to take all they were decreed, there was enough to satisfy most of the demands. As the lands under these ditches were brought under cultivation there was an increased use of water all along the line, until there was shortage. Then the injustice of the decrees began to be felt. The use of water by newcomers under the canals having the earlier rights took water away from those who had been using water perhaps for years from canals having later rights. The expansion was not limited to using larger volumes but the time of use was extended. Ditches which served small areas and diverted water only part of the time were made to serve more land and diverted water continuously during the irrigating season; land which was used for crops which required water only during the time when the streams are high were planted to crops which required water late in the season when the streams are low. All of these enlargements were at the expense of the holders of the later rights, and if the early rights had been limited to the quantity beneficially used at the time the later rights were acquired the enlargements could not have been made. As a rule, the increased use was well within the decreed rights of the earlier ditches, but this did not lessen the hardship on the holders of the later rights.

The same expansion in use is not possible under the Wyoming and Nebraska systems properly enforced. Irrigators are granted rights to sufficient water for certain areas, rather than fixed volumes. The volume used on a farm may increase with a change in the nature of the crops raised, as in Colorado, but this increase is small when compared with that which takes place when both the area and the use increase. It is, however, just as truly a departure from the principle of beneficial use and the hardship to the holder of the later rights is less in degree only.

It is in connection with this increased use that transfers of water rights have been most objectionable. In many cases ditch owners who received decrees for more than they had used or needed to use, or more than their ditches could carry, sold the surplus to which, under the principle of beneficial use, they had no right. They continued to use as much as ever, while whatever was used by the purchasers of their surplus rights was taken from the holders of later rights. However, this can not be charged against transfers, as such, since if the rights had never been recognized they could not be transferred.

As to the effect of differences in the nature of the water-right systems of the three States on the just division of the water of the Platte River between the States, the preceding pages show that physical conditions are such that there will be little occasion for controversy as to the division of the water of the North Platte between Colorado and Wyoming and that water rights in Wyoming and Nebraska are based on similar laws. The nature of the rights will not therefore affect the just distribution of the water of the North Platte between Wyoming and Nebraska. Although in general rights in Colorado and Wyoming differ in their nature, the Colorado decrees defining rights to water from Laramie River are exceptions to the rule and base rights on the needs of given areas of land, making them similar to rights to water from the same stream in Wyoming.

The rights to water from the South Platte in Colorado are to definite volumes of water based very largely on liberal estimates of ditch capacities rather than on the volumes of water which had been used at the time the rights were adjudicated. Rights in Nebraska entitle their holders to sufficient water for given areas with the limit of 1 cubic foot per second to 70 acres. It is pointed out in the enumeration of the rights to water from the South Platte that in both Colorado and Nebraska rights very largely in excess of what had been used or the stream supplied at the time the rights were adjudicated have been recognized. Since these rights in Colorado are for definite quantities of water, as time goes on the tendency will be for the use to increase up to the full volumes decreed, and for this water to be spread over larger areas as economy in use takes place. On the other hand, rights in Nebraska being based on the need of particular pieces of land, the volumes used will be limited to those needs, which will tend to diminish as the time that the land has been irrigated lengthens. The nature of her water rights, therefore, gives Colorado a theoretical advantage in the distribution of the South Platte. As shown by the tables of stream flow and of rights, the rights in Colorado prior to any in Nebraska exhaust the stream, and practically all the water which goes to Nebraska is local drainage and return seepage which can not be diverted in Colorado, and therefore the theoretical advantage has little to do with the division of the water.

CONCLUSION.

The foregoing report seems to justify the conclusion that under existing physical conditions and in view of the dates of the acquirement of existing rights the enforcement of rights as based on the laws of the three States will do no substantial injustice to the irrigators in any one of the States. As between the States therefore, the whole question resolves itself into a matter of distributing the water of these streams to existing rights regardless of State lines. This can be accomplished by agreements between the States, but if it is not done in that way justice will demand that the Federal Government provide for this distribution.

WATER RIGHTS WITHIN THE STATES.

By Elwood Mead,
Chief of Irrigation and Drainage Investigations.

Rising in South Park, southwest from Denver, and fed by the snows of the eastern slope of the Rockies, the South Platte River irrigates one of the best-farmed sections of the arid region. Rising in North Park, northwest of Denver, the North Platte irrigates a number of separated areas which are being farmed with constantly increasing skill and success. The two streams unite near North Platte, Nebr., and form the main Platte River. Irrigation extends below this junction a short distance, but at the eastern end of the river the climate is humid and the value of water is neither fixed nor important. It is, therefore, omitted from this discussion.

The arid portion of the river's drainage has an area about equal in size to the State of Ohio or the State of Virginia. Within this area the water needed for household and domestic purposes, for irrigation, for cities and towns, and for factories and power purposes comes from the river and its feeders. Fifty years ago this water had a limited use by Indians and travelers on the overland trail. The freighter voted the river a nuisance. He would have laughed at the idea that a right to control part of its flow would some day be worth more than a gold mine, because its value is more enduring. No one foresaw the potential riches of the river which are now being realized. To-day it irrigates 1,924,463 acres of land. Before irrigation this land was a desert. Now the best land sells for $300 an acre, and none that is irrigated sells for less than $10 an acre. Fifty years ago the only settlements were outlying forts and a few stage stations. To-day Denver and its suburbs have 200,000 people, Cheyenne has 15,000 people, and there are a score of other towns having from 1,000 to 10,000 people.

In the entire Platte drainage there are 728,000 people. Of these probably 500,000 live in the arid portion. Within this territory manufacturing has already become an important industry. There are great smelters for the reduction of precious metals. Rolling mills, machine shops for railways, flour mills, paper mills, cotton mills, and beet-sugar factories are illustrations of the diverse character of the factories already established. The wealth which they represent runs into tens of millions. The exact amount is not important, because it is being augmented every day. This river and its tributaries are the arteries which feed these industries. Every farm must have water to be productive; not a factory could run without water to feed its boilers; not a household could be maintained without water for domestic uses; all present development and all prospective development depends on the flow of this stream.

Thousands of miles of ditches and laterals have been built to divert and distribute this water supply; scores of reservoirs have been constructed to catch surplus and flood waters; wells are being dug, ditches and canals excavated to capture underground streams and water which escapes from irrigated fields as waste or from ditches as seepage. The amount expended on works to distribute water among users can not be definitely ascertained, but in the aggregate it is many millions of dollars, and the expenditure, if ascertained to-day would not answer for to-morrow, because the extension of old works and the construction of new ones is constantly going on.

When the first ditches were built the idea of the water itself having a property value was not considered. The prices charged for water rights in the first place were fixed by the cost of ditches and varied from $2.50 to $4 an acre. To-day water has a value entirely independent of the cost of diversion works or of the service required to distribute it among users. This price is fixed in part by the fertility and productiveness of the land, by the nearness to cities and towns, and by the priority and legal status of the right in the stream. The older the right the greater its value. Water rights which originally sold for $4 an acre now sell for $35 an acre, and stored water sells for even higher prices. The rental of enough water to irrigate an acre of land has reached $15 a year.

Factories and cities can afford to pay more for water than farmers, and as cities and towns grow and factories multiply their demand for water will tend to augment its price. Thus far on this stream the use of water for power purposes has not assumed great importance, but in some sections of the West—notably in Utah and California—early water rights are being bought by the owners of electrical power plants for the purpose of exercising control over the flow. The limit on prices for water rights in the future can not be foretold. It will be affected by the growth of cities, by the profits of agriculture, and by the limitations placed on speculative ownership of streams. If only rights to use are recognized, then the values will inhere in the farm and in the factory rather than in the water; but if rights to the water are made personal property, there is danger of water monopolies which will virtually control the values of all kinds of industries which depend on water.

The extent to which cities and towns are to absorb this water supply and the influence which their growth will have on the value of water has not received much consideration, but that it is to be an important factor is shown by the growth of the appropriations of water for the city of Denver. Originally its water right was for 30 cubic feet per second. Later there was added to this 13 cubic feet per second. When no more water was to be acquired by appropriation, additional rights were purchased, until to-day the corporation which supplies the city holds rights to 420 cubic feet per second for direct diversion and additional rights to an immense volume for storage in nonirrigation periods. In the arid region cities are large consumers of water. The needs for lawns and for streets are greater than in humid districts. The city of Cheyenne has an appropriation of 12 cubic feet per second, which is more than the average flow of the stream and more than has ever been used, but as the city grows the consumption of water will also grow until it absorbs the stream or equals the right. As all the water not taken by the city is used by irrigators, every increase in the city's consumption cuts down the supply of irrigators. Denver, Greeley, Fort Collins, and other cities in Colorado; Cheyenne, Laramie, Casper, and Douglas, in Wyoming, and other cities and towns in Nebraska must in time make a marked inroad on the supply and are a factor to be considered in fixing the ultimate limits of irrigation.

The preceding pages of this report show that the average volume of water supplied by the South Platte and its tributaries from April to September is 2,765 cubic feet per second, and the decreed rights to this supply aggregate 30,597 cubic feet per second, or more than ten times the supply. The average flow of the North Platte at Guernsey, Orin, or Douglas (see p. 24) from April to September is 4,013 cubic feet per second, and the decreed rights to water from the North Platte and Platte below that point aggregate 11,173 cubic feet per second, or nearly three times the supply. This situation is well understood, but the need for water and its prospective value is so great that appropriations are being made more aggressively than ever before. In 1903–4 filings from the South Platte drainage in Colorado were made on 11,842 cubic feet of water per second, and for 2,282 cubic feet per second from the North Platte drainage. In the same time filings on the South Platte in Colorado to fill reservoirs aggregated 39,802,168,745 cubic feet; on the North Platte drainage in the same State, 200,120,042 cubic feet. The records of Wyoming and Nebraska show corresponding activity. Many of these filings will be abandoned, but many will be followed by construction, and with each mile of new ditch built, each additional acre of land irrigated, the struggle over water ownership will become more intense and the need for a definite understanding of the nature of titles to water more imperative.

The situation along the Platte is not peculiar to this river or to arid lands. It is one of innumerable illustrations of the constantly increasing importance of water to the health and comfort of man. Increasing use and augmented value is bringing about a fundamental change in the legal and economic status of streams which is profoundly affecting property values and social conditions throughout large areas of this country and is destined to exert a still more commanding influence in the future. Water is ceasing to be regarded as valuable because of its relation to other forms of property, but is coming to be dealt with as a commodity valuable in itself, like crude oil from wells or coal from mines. This is especially true in arid lands and in the vicinity of great cities. The facts disclosed in this report show that under laws and court decisions rights are being established to the flow of creeks and rivers, which are being bought and sold like warehouse receipts for grain. It is, therefore, highly desirable that the subject of property rights in water should receive more consideration from trained investigators of economic problems than has hitherto been given. Especially is this true in the arid region, where the right to use water lies at the very foundation of development and where its control, unless subjected to wise limitation, will in time reap all the benefits of that development. The need of expert and disinterested study is made all the more urgent because, as stated in President Roosevelt's first message, "We are now in the pregnant years when institutions are forming." The rights to water now being acquired under the liberal policies adopted in western States are made perpetual. They have not only great present value, but are certain to affect the welfare of a large part of the people of that region for all future time. Unless they are subjected to proper limitations, there is danger that they may in the future embarrass or prevent the adoption of legal principles needed to protect the public welfare and prevent enduring wrong.

Primarily this report is a discussion of two features of stream ownership and control. One is the division of the water of a stream between States, and the other is the relation of the rights of appropriators of water and of riparian proprietors to each other where both exist on the same stream. The Platte River has been dealt with because it is one of the best concrete illustrations of both these problems. Three States are dealing with the same water supply. In one State, Nebraska, the laws recognize both rights of appropriation and common-law riparian rights. As these questions are quite fully discussed by Mr. Teele in the preceding pages, this paper will only consider the character of the appropriations of water now being made in each of the States through which the river flows. This is the fundamental question. A division of water between States requires that the rights in each Commonwealth be adjusted to a common standard. This involves both a clear understanding of the principles which should be adopted to secure justice and the social well-being of the people and the manner in which the rights to water in the three States approach or depart therefrom.

THE EVOLUTION OF PROPERTY RIGHTS IN WATER.

The primitive conception that water, like air and sunshine, is one of the gifts of nature which are free to all alike, does not need to be questioned in sparsely settled or uncivilized regions, but this conception must give way when countries become densely populated, or when special industries, like agriculture by irrigation, make so large demands on streams that there is not enough water for all. Free water on Manhattan Island is no more a possibility than free forests, and to talk of free water around Denver would be like talking of free coal. Great cities consume enormous quantities of water, the rate of consumption seeming to grow with advancing civilization. It requires all the water of a large territory to meet the needs of cities like New York, Boston, and Philadelphia. This consumption necessitates the absorption of streams and the extinction of vested rights in those streams. The common-law doctrine of riparian rights is as unsuited to these conditions as the old-time stagecoach is to the demands of modern travel. Hence new legal remedies must be devised. The last legislature of New York passed two important water laws, which illustrate this. One created a city water commission to ascertain where New York City can obtain a supply of pure, wholesome water. The other created a State commission whose consent must be obtained before any city or town can take a water supply by condemnation. This is State ownership or control of public water supplies far in advance of many arid States. Even in England, with its rainy, foggy climate and a soil requiring drainage because of surplus water, the long-established riparian doctrine is having to give way because of the increasing use of water. To meet the enormous consumption of London, surface and underground streams are being diverted into pipe lines and carried by means of pumps many miles away from the original channels. This is a violation of the common-law doctrine, because under it the rights of riparian lands were inalienable.

In densely populated countries like Italy, Germany, Switzerland, and France, the water of streams is under private or public control, notwithstanding the fact that the climate of each of these countries is humid. In cities water is now used for a multitude of purposes which had no place in the life of primitive peoples. The inventions which led to the use of steam as a motive power enormously increased the consumption and industrial importance of water. Improvements in machinery to utilize differences in level in the generation of power, and the marvelous electrical inventions by which this power is transmitted to remote cities, have given to streams an entirely new and hitherto unthought of value. In nearly every industrial enterprise, great or small, water is an indispensable factor. It feeds the steam boiler, it cools the jackets of steel furnaces, it is the solvent in most chemical processes, and is turned to use and made an agent in the creation of wealth in a multitude of ways which need not be enumerated.

Moisture is necessary to plant growth, and in arid lands this moisture is supplied largely from streams. Hence in such regions the right to use rivers in irrigation is an indispensable requisite to any large creation of wealth in lands. As population increases and civilization advances, there is not only a more extensive but a more intensive use of water. The higher the standard of living and the greater the skill of artisans, the greater is the number of needs of the household and the larger the number of uses to which water may be put. So extended have the demands for water become in arid and in many humid sections that the resources of individuals are entirely inadequate to meet them, and great corporations are formed for acquiring water, constructing dams, building storage works, canals, and pipe lines for the conveyance and distribution of water for different purposes. The future of New York City was menaced a few years ago by legislation which gave to a powerful private corporation the exclusive right to acquire water supplies needed or likely to be needed by that city.

No field of engineering has made greater advances within the past half century than that connected with the regulation and distribution of water. These are shown in the lessening losses from seepage and evaporation, in the lessened cost and increasing durability of structures, and in the inventions and devices for the accurate division and measurement of water. A similar advance has been made with respect to the utilization of water supplied from beneath the earth's surface. Large sums of money are being expended in investigations to determine the extent and location of underground waters. Skilled engineers are constantly making improvements in the methods of boring wells, building tunnels or galleries to intercept underground streams, and in cheapening and simplifying pumps and engines for lifting water to the earth's surface. State experiment stations and the Department of Agriculture are studying how economy in the use of water in irrigation may be promoted, and cities find waste in domestic water supplies a serious evil.

There is nothing in farming where rainfall is ample which corresponds to the intensity of feeling which marks the struggle for control of streams in arid lands, or the anxiety which besets irrigators regarding the stability of their water titles. The farmer who remains serene of spirit when he sees his fields burning for lack of water and knows that his loss of crops is due to wasteful use by others is a rare if not impossible character.

Advancing civilization has done more than augment the uses and value of water; it has increased the evils and dangers arising from water. The ice gorges along the Ohio and Mississippi rivers were a matter of small concern when Indians were the only people concerned. Now they often cost millions of dollars and hazard many lives. Hence immense sums of money are being expended to protect commerce from their action. Every reservoir, every diversion dam in a stream, every artificial waterway adds a new element of danger and insecurity to the lives and property below and gives ground for new laws and regulations with respect to the management of water. The swamps and marshes created through the interruption of underground water supplies by impervious strata are a matter of small concern in sparsely populated regions, but in highly civilized countries they seriously impair the value of lands for agriculture and become a menace to the health and prosperity of cities and towns.

HOW THE PLATTE HAS BEEN APPROPRIATED.

In Wyoming and Nebraska the water of the Platte River is a State property. In order to divert it one must secure a permit from the State. In each State there is an administrative board which has control of the appropriation of water and of its distribution among the parties acquiring rights to its use. The theory of State ownership and the manner in which State authority is exercised is in many of its features analogous to the Federal ownership and management of public land. There is no such administrative machinery to govern the acquirement of water rights in the river in Colorado. The State exercises direction over the filing of claims and the building of dams, but it does not assert any control over the number or location of ditches, and the courts have held that the State can not enact laws either to fix the place where water is to be diverted or to restrict the building of diversion works. There is not water enough for all the ditches that can be built, and to build more ditches than can be filled means either that the money spent on the last one will be lost or that filling it will rob some earlier appropriator. These two things have been conspicuous features of the assumed generosity of the Colorado water laws. After ditches are built the law in that State can be invoked to prevent any water being turned in them, but no one is permitted to prevent the waste of money or conflicts over water which this lack of supervision involves.

In Wyoming and Nebraska any one permitted to divert water from the Platte has the amount and limitations on his right fixed in the permit. Compliance with its conditions is all that is necessary to establish his appropriation. Hence in these States every step in the acquirement of a water right is an administrative act. In Colorado the courts decide what the right is after the appropriation is made, fix the amount, and determine the order of priority. All three States have declared that water is public property.[a] In Wyoming and Nebraska the basic idea in interpreting this provision is that this water is a public property; that the giving of a right to it is a surrender by the State of a public resource. In Colorado the basic idea is that the stream is there for everybody to take, and that the settlement of rights to it is a question which concerns only those who are seeking to acquire it. The State or the public in Colorado is never represented in the establishment of appropriations. No one appears in water-right adjudications but the appropriators. Where there is an actual scarcity of water the controversies are usually genuine and conflicting interests prevent the acquirement of excessive rights, but in the earlier litigation over this matter the necessity for restricting appropriations was not felt. Hence it sometimes happened that instead of attempting to restrict each other to their actual needs or uses the appropriators agreed among themselves as to what each one's share should be and submitted testimony in accordance with this agreement. The vested rights to some of the tributaries of the South Platte were established in this manner.

The water laws of Wyoming and Nebraska have several advantages over those of Colorado. The method of establishing rights is simpler and cheaper, and the results are more nearly in accord with actual uses than in Colorado. The full benefits of the Wyoming and Nebraska plan have not been reached because public sentiment will not support irrigation officials in enforcing regulations which rigidly limit rights to water in streams. We are as yet in the pioneer stages of development. The public resources are so great and the number of people using them relatively so few that men look with impatience on the efforts of those who seek to restrict the acquirement of these resources. Appropriators of water are not altruists. This applies to the irrigator who seeks water for his own land as well as those who appropriate water to rent or sell to others. All wish to make these appropriations in the easiest and cheapest way and to secure the largest possible amount. Practically, every appropriator would prefer absolute ownership. Where this is not possible they seek the nearest equivalent. So far as the general public is concerned, it is indifferent. Every perpetual right to water acquired means a lessening of water for future appropriators, and every excess right allowed is a surrender of a birthright of future generations; but this fact does not awaken any protest against prodigal generosity either in the establishment of rights or in extending the privileges which accompany these rights. "Let the future take care of itself" is the prevailing sentiment. This sentiment is not peculiar to the West. The East has given away streets; the West, rivers. Irrigation officials have struggled against this. The reports of the engineers in each of these States have been filled with protests against this mistaken liberality and warnings against the dangers of personal or speculative ownership of streams. The most serious obstacle in Colorado to a proper limitation of rights for irrigation has been the provision of the law which gives appropriations to ditches and requires decrees to state the carrying capacity of ditches. This, as is explained later on, is not a determination of actual beneficial use, but of what has been taken as a convenient substitute.

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[a] *Colorado and Nebraska.*—"The water of every natural stream not heretofore appropriated, within the State of Colorado (Nebraska), is hereby declared to be the property of the public, and is dedicated to the use of the people of the State, subject to appropriation as hereinafter (hereinbefore) provided." Colorado Const., Art. XVI, sec. 5; Compiled Statutes of Nebraska, sec. 6450.

Wyoming.—"The water of all natural streams, springs, lakes, or other collections of still water within the boundaries of the State, are hereby declared to be the property of the State." Wyoming Const., Art. IX, sec. 1.

The laws of these three States all require that water must be beneficially used before a right to it can be established. No State can sell a share in a stream, nor can it give it away to anyone else but a user. The first user has the first right and the priorities of subsequent users are fixed by the time of original use. The rights of later appropriators are subject to the earlier ones. If there is not water enough in the stream for all the last appropriator has to do without, and the early rights are the last to be interfered with. The priority of an appropriation is, therefore, a controlling factor in determining its value. Early rights are far more valuable than later ones.

In the arid West there is more land suited to irrigation than there is water to irrigate it. Control of the water means, therefore, control of land values. The danger of water monopoly will be lessened if the ownership of the land and the right to water are united in the same person. This gives to the farmer control of both elements of production and conduces to the security and confidence with which he carries on his work. The history of all irrigated countries shows that making the water of streams a form of property apart from land leads in time to their speculative ownership and to water-right charges which are a severe tax on agricultural development and prosperity. Speaking of this, President Roosevelt, in his first message to Congress, said: "Separate ownership of land and water can not prevail without causing enduring wrongs." Those provinces in

Spain where land and water are united have, without exception, a highly developed agriculture and contented and prosperous farmers. Those provinces where the ownership of land and the right to water are separated are provinces with a decaying agriculture and a discouraged and impoverished body of farmers. Formerly the same statement was true of Italy, but since the assertion of governmental control over streams and the fixing by the Government of the conditions under which water is delivered to consumers, much has been done to mitigate these evils. More is being done by the gradual condemnation and purchase of the old personal-property rights by farmers' cooperative associations, thus bringing about a union of the water right and land ownership.

Along the Platte River the danger of separate ownership of land and water is magnified by the mistakes made in the establishment of the amount of the early appropriations. Nearly all of these were for greater volumes than had actually been used. These rights are perpetual, and if they become separated from any particular place of diversion or any particular place of use there is grave danger of a water monopoly. The enormous aggregations of wealth in few hands and the abuses which have attended the formation of trusts and monopolies of other natural resources leave no question that legislation should seek to prevent the establishment of monopolistic control of streams. A monopoly of water would be worse than a monopoly of oil or iron, because in the case of either oil or iron new stores of these materials may be found; but whoever acquires a right to all the water of a stream has a monopoly which can never be broken. Water can not be shipped in from the outside, and there is no hope of the discovery of additional supplies.

The danger of transfers and the danger of sales of water rights lie in the recognition of such ownership as will permit one individual or one company to acquire all the rights to a river and fix the conditions on which the supply will be disposed of to users. The question we have to consider in these States is whether a right to *use* water, as stated in their laws, means the same thing as a right to *sell* water. In each of these States the foundation of an appropriation is the *use* of the water, and the right granted is the right to *use;* and if this is rigidly construed it would seem to mean that only a usufructuary right is acquired. If this is true, when A irrigates his land to acquire a right, all that he acquires is a right to divert from the public water supplies the amount needed to continue that irrigation, and the needs of the land will for all time be the measure of the right. It is not maintained that this view has prevailed in the establishment of rights or in the interpretation of their character by the courts, but it is believed that to carry out the intention of the statute this is the view which should have prevailed. Instead of this idea of use governing the right, the language of the statute is construed to mean that in order to maintain an appropriation the holder of it must either use the water or provide for its use by others. That is, he can not hold the water unused. There is thus established a property right in the stream, and instead of the necessities of the land irrigated being the measure of the right, there is acquired an appropriation of a certain number of cubic feet of water per second as an equivalent of the amount originally used; then the idea of beneficial use soon loses its practical significance. If, in addition to this, A and B and C, after they have each acquired a right to a certain number of cubic feet of water per second, can sell those several rights to D, and D in turn can combine these several appropriations and peddle out the water so controlled to individual users, the language of the statute regarding beneficial use becomes largely meaningless as a limitation on appropriations. If A and B and C can sell their rights to D, why should the State insist on beneficial use at the outset? Why not the State sell this right to D in the beginning? Why not do directly what is accomplished in this way indirectly? Why assume to create users' rights when really creating property rights in the public water supplies?

Another danger of recognizing sales of appropriations in a running stream and the shifting of the diversions of water which goes with these sales is that it offers a serious obstacle to the action of the State in dividing the stream between appropriators. It must be kept in mind that the water diverted is not all destroyed. A considerable portion returns to the stream as waste or seepage. In some cases as high as 70 per cent of an appropriation comes back to the stream and is available for the use of other appropriators below, and on an average one-third of the water diverted comes back. Manifestly the location where an appropriation is used has much to do with the value of rights below it. If priority No. 1 is originally diverted above priority No. 2, No. 2 can not only avail himself of the surplus water which passes No. 1's head gate, but of the seepage water of No. 1's appropriation which returns above No. 2's head gate; but if priority No. 1 is later on sold and moved downstream below the head gate of No. 2, then No. 2 loses all the benefit of return seepage. It is true that the laws state that transfers shall not be made which injuriously affect the rights of other appropriators, but until recently these laws have put on other appropriators the burden of protecting their rights through litigation, and many grave injustices have been consummated because those injured had not the means or time to engage in litigation. In all cases the question of injury should be determined by an impartial investigation of the State engineer's office, and no transfer should be authorized until it has been examined and approved by the State irrigation authorities. It requires expert knowledge of the irrigation conditions of a stream to determine the exact influence of a transfer. The full effects of return seepage do not manifest themselves the first year, nor can they be foretold in all cases. Hence when appropriations are shifted from year to year there can be no stability or certainty with respect to the amount of return seepage or the volume of water which the water commissioner can count on at any point in the stream as available for the use of appropriators. Without a knowledge of the manner in which the stream loses water by evaporation or is augmented by seepage, it is inevitable that great injustice in the division of the water supply between priorities must result.

Refusing to permit of sales of appropriations and restricting rights to the use by which acquired has this inestimable advantage: It insures stability so far as return seepage is concerned. Where an appropriation is always used on the same area the return waters always reinforce the stream in the same place and are always available for the same users below. Under this interpretation of user's rights, A, when he irrigates his quarter section, acquires only a right to the water needed for that quarter section, and if he ceases to irrigate this land his right ceases and the appropriation reverts again to the public. The statutes of many of the States seem to be based on this idea, as they state that wherever a use ceases the right ceases.

If appropriations are measured by some particular use, those for irrigation will vary in the different months of the irrigation season with the needs of the crop grown on the land, and they will vary somewhat in different years. In a rainy year little water will be required; in a dry year more. The right will be limited to the irrigation season. This on the Platte will be for about one-third of the year. Mr. Adams found the average length of the irrigation period in 1903 was 114 days. The records of irrigation on the Arkansas in 1904 showed the average for the season on that stream was 69 days. Such rights differ widely from an appropriation of a certain number of cubic feet per second flowing continuously. These are not rights of use, but assumed equivalents of such rights. They give a surplus in August and September, when water is most valuable, or, if based on the quantity used in August, limit irrigators unjustly in June. Hence a right to a uniform flow of a certain number of cubic feet per second is never in exact accord with the actual requirements of irrigation.

The canal companies, which have acquired large appropriations of water for supplying the needs of farmers instead of for use themselves, have recognized the necessity of attaching the rights which they grant farmers to specific tracts of land. The contracts of these companies for perpetual water rights always describe the land on which the water is to be used, they limit the amount which will be furnished to the needs of that land, and do not permit the farmer to apply any surplus he may have to other lands.

Uses of water for other purposes than irrigation may require a uniform continuous volume, and hence the granting of a right to a uniform continuous flow is not an equivalent of the actual use, but based on actual use; but even in these cases where these rights can be severed from such use and applied to a different use, they cease to be usufructuary rights and become property rights. They may be and often are fair equivalents of the original user's right, and if this original right was not for an excessive amount of water one of the grave evils of transfers is avoided, but along the Platte practically all of the early rights were for an excessive amount of water, and the danger of substituting an equivalent for the original use is that it destroys the original measure by which excess might in the future be corrected and turns the mistake originally made into a valuable speculative property. Where an original right for irrigation is restricted to the original number of acres, the owner can never make use of the surplus without destroying his land. On the contrary, as the subsoil becomes filled and his methods become more skillful, care for profits will compel him to take less and less water from the stream. But if he can sell his appropriation the way is open to turn this excess into money, and his interest in irrigation becomes secondary to his interest in the property he has in the stream. His ingenuity is not directed toward the skillful use of water, but to making trades which will extend his control over the stream. No one familiar with the transfers of appropriations in Colorado and the litigation which has grown out of these transactions during the past fifteen years can doubt that if water rights had been attached to the land irrigated it would have been a great gain to the peace and welfare of the farmers of that section. The different reports of the State engineers of Colorado and the information contained in Bulletin 118 of this Office, on pages 49 to 75, fully support this conclusion.

Most of the irrigation rights to the Platte River and its tributaries in Colorado are described as a constant flow of a certain number of cubic feet per second. They are therefore assumed equivalents of actual uses. In some respects they resemble warehouse receipts for grain—that is, the holder of an appropriation has a right to demand a certain amount of the flow of the stream every day. It differs from a warehouse receipt in this: He can not hold it out of use or claim credit if he fails to use it or provide for its use; but in Colorado, if he does not wish to use it himself, he can lend (?) it to some one who does, and as water becomes more valuable the inducements to lend appropriations and thus utilize to the utmost the early rights to the injury of subsequent priorities will almost inevitably be augmented.[a]

Reference has been made to the fact that the early rights were largely in excess of actual uses. One of the early appropriations of water in the Territory of Wyoming would have covered all the land irrigated to a depth of about 560 feet in a single season, whereas 3 feet would have been an ample allowance. One of the early appropriations of the Cache la Poudre River gave 32 cubic feet per second for the irrigation of 320 acres of land. Four cubic feet per second would have been a liberal allowance; hence there was an excess in this case of 28 cubic feet per second. As long as these excess rights were attached to a particular ditch or a particular tract of land they worked no serious harm, but when these rights are separated from the original place of diversion and use it gives the appropriator a valuable property for which he has rendered no equivalent to the public, and demoralizes the efforts of the State irrigation authorities in trying to secure a just division of the stream among actual users. Captain Boyd, in his History of the Greeley Colony, explains that at the outset the irrigators of Colorado believed that these rights were attached to the ditches through which the appropriations were acquired and could not be separated from them. The discussions of this question in the early numbers of the Colorado Farmer and the conversations of irrigators and ditch owners with the writer from 1882 to 1885 were all to the effect that the excess rights of the early appropriations would never amount to anything, because the water decreed could only be used on the lands under those ditches, and the law which gave the water commissioner authority to prevent waste would limit the quantity diverted. When the first sale of one of these excess rights took place there was a general expression of indignation by other irrigators over its recognition by the water commissioner, showing that this idea of an appropriation was not in accord with the natural sense of justice of water users.

Another thing which has tended to destroy the idea of use as a measure of a right has been the establishment of appropriations before the water was used, and in some cases before the ditches were completed. The appropriation of the Larimer County ditch, in Colorado, was declared vested by the court before the ditch was completed and manifestly before all the water had ever been used in any way, and this is only one illustration, of which numbers might be given.

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[a] Since the above was written the supreme court of Colorado has rendered a decision greatly restricting the loaning of appropriations of water and curtailing the abuses which threatened to grow out of this practice. This decision is a most important one and one which recognizes the true principles of an appropriation.

"Under Sess. Laws, 1899, p. 236, c. 105, *held*, that a senior appropriator, who did not need water for his own land, could not, by loaning it, pass over appropriators junior to him and confer it upon other appropriators junior to those ignored, where such loaning would operate to the injury of the ignored appropriators. (Ft. Lyon Canal Co. *v.* Chew (Colo.), 81 Pac., p. 37.)

The water laws of Wyoming and Nebraska were framed after the evils of transfers of appropriations had become manifest in Colorado. In order to avert these evils the lands rather than the canals were made the appropriators of water. To acquire a right for irrigation the land had to be actually irrigated, and the right to water, in the certificates of appropriation issued, is attached to this land. Instead of giving a right to canals to a certain number of cubic feet per second, as is done in Colorado, the certificates of appropriation in Wyoming and Nebraska name the appropriator and the diverting ditch, but give to the land described a right to water sufficient for its irrigation, fixing, however, a maximum limit on the amount which can be taken, this maximum being an arbitrary and probably an unconstitutional restriction, but designed to prevent wasteful or excessive use. In both States the maximum allowance is 1 cubic foot per second to 70 acres, which is largely in excess of ordinary necessisities. This was proven in several instances in Wyoming. Appropriators claimed the right to take more water. They were notified that if a measurement showed they used more this right would be recognized. Measurements showed they used less.

There being no law authorizing a transfer from the land where acquired to other lands or to other uses, it has been held by the State irrigation officials in both States that the right was restricted to the place where acquired, that being the sole measure of use provided by law. The water laws of Wyoming and Nebraska are practically the same. The irrigation officials of both States have construed these laws as restricting rights to the place where acquired. This interpretation was upheld by the supreme court of Nebraska in a decision rendered in 1904.[a] In this decision the Nebraska court referred to the Wyoming statute and its resemblance to the Nebraska law and held, in effect, that both laws attached rights for irrigation to the lands where acquired, a portion of the decision reading as follows:

> By the adoption of the irrigation law of 1895, which was modeled upon the Wyoming law, this State adopted the latter policy, by which the right to use the water shall not be granted separate from the land to which it is to be applied, and that the right to use the water should attach to the land, and when the land is sold be sold with it.

The Wyoming State irrigation law was passed in 1890, carrying into effect the constitutional declaration which conferred on the State board of control authority to deal with the appropriation of water and its diversion and use. For fourteen years the board of control ruled that appropriations of water were limited to the uses for which acquired. During this time the irrigation interests of the State enjoyed a conspicuous freedom from controversy and litigation over water rights, which was in marked contrast to the numerous and costly controversies of all the surrounding States save Nebraska. In 1904, however, this ruling was set aside by a decision of the supreme court, which held that appropriations of water in Wyoming are property rights which can be sold and by the sale separated from any particular use.[a] As this decision vitally affects rights to the Platte and its tributaries in Wyoming and is, in addition, regarded as establishing a dangerous extension of water ownership, a brief statement of the underlying facts seems warranted.

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[a] Farmers' Irrigation District *v.* Frank, 100 N. W., 286.

The litigation leading up to this decision grew out of a sale of a prior appropriation on Little Horse Creek, in which there was sought to be conveyed a right to the use of 10 cubic feet of water per second for one-half of the time. The attempted seller of this right had received a certificate of appropriation from the board of control, giving a right to water sufficient for the irrigation of 700 acres of land, not at any time to exceed 10 cubic feet per second. The land entitled to this water was named in the certificate of appropriation and more definitely located on the maps of the State engineer's office. As the use of water in irrigation is intermittent, the holder of this prior right seldom used 10 cubic feet of water per second, and prior to this sale when he did not use the full amount of his appropriation the second appropriator took it. When the second appropriator had a surplus, it went to the third, but the third's periods of use were infrequent, and to improve his position in the list of priorities he bought the right to No. 1's appropriation for half the time, thus practically displacing priority No. 2. After the sale No. 3 called on the water commissioner to turn the water alleged to have been purchased where he directed, instead of giving it to No. 2, as would have been done if the regular order of priority of appropriation had been followed. The water commissioner, acting on the advice of the State engineer, refused to recognize the sale as valid and litigation followed, ending in the supreme court sustaining the transfer.

The refusal of the water commissioner to recognize the sale was based on the following objections to its validity:

(1) That the original right was not for 10 cubic feet of water per second, but for the water needed by a certain tract of land.

(2) That there was no law authorizing the separation of this right from that land.

(3) That there was no measure for the right when separated from the land. He could not tell how much to deliver to the purchaser.

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[a] Johnston *v.* Little Horse Creek Irrigating Company, 79 Pac., 22.

(4) That, the right being for use, it could not be sold. If No. 1 did not wish to use the water, it belonged to No. 2.

There were certain other features of this sale which make its validity a menace to the State's agricultural development. The seller of the right does not relinquish the right to irrigate a single acre of his 700. The buyer does not designate how many acres he proposes to irrigate, or whether he will use it for irrigation. He does not name the ditch in which his purchased right is to be turned.

The water commissioner or the State board of control has no official knowledge as to where the purchaser of this right will use the water next year, or apparently any official control as to the ditch into which it shall be turned or the land on which it shall be used. The laws of the State require careful surveys to be made at the State's expense to determine the lands entitled to water, but if the right can be separated from these lands without any examination and shifted from place to place without any control by the State authorities, then this expenditure in the location of the irrigated areas is a waste of time and money. The State board of control is by the constitution given control over the appropriation of water and its distribution, but this board was not consulted with reference to this sale. No copy of the deed of transfer has ever been filed with the board. Except for the litigation, its authority in this matter was never recognized. Even now the board has no official knowledge of where the water purchased is to be used and no standard by which it can limit the area to which it is applied or protect whatever rights priority No. 2 may have in the running stream. The decision seems to be based on the assumption that there was granted to the first appropriator a right to 10 cubic feet of water per second of time. If this assumption were correct, then there would be a strong presumption that the holder of the certificate of appropriation was authorized to sell his right to this water for half the time, but this assumption is not supported by the certificate which first defined the right and is not in accord with the rulings of the board of control in interpreting these certificates, the language of the certificate in this case being: "The Springvale Ditch Company, by reason of the construction of the Springvale ditch and the beneficial use of water for irrigation, is entitled to sufficient water from Little Horse Creek to irrigate 700 acres of land."

This, as was pointed out by State Engineer Bond, in his report for 1899–1900, page 45, is something entirely different from a right to a continuous flow of 10 cubic feet per second or any fixed volume of water.

Such an interpretation of the certificates issued by the State board of control will greatly expand the volume of water controlled by them over that controlled under the interpretation heretofore maintained by the State irrigation authorities. As stated, these certificates give only a right to the maximum amount of water during the times it is needed. Under this recent interpretation it gives a right to the maximum amount of water all the time. It renders practically meaningless the law requiring the water commissioner to prevent waste. If each right is for a certain number of cubic feet per second flowing all the time, then the appropriator, if he does not desire to use it all the time, can, as in the Little Horse Creek case, sell it to some one who does. What should be treated as a surplus becomes a property of great speculative value.

Repeated measurements in Wyoming have shown that water is not used in irrigation more than one-third of the year, and the maximum amount is not used more than thirty days in the year. The tendency of this decision will be to augment the value of early rights by extending the use of water under them. It is true that the decision holds that increased use is not lawful, the language being as follows:

> An individual appropriator of water for irrigation secures no surplus water; hence he has no surplus which he can either sell or give to another, as against subsequent appropriations. His appropriation, and therefore his water right dependent thereon, is at all times limited, within the maximum of his appropriation, to the quantity capable of beneficial use and actually so used. If during any period he does not require the use of the water, it falls during that period to the subsequent appropriator who does need the same and can beneficially use it. * * * In other words, the burden upon the use must not be enlarged beyond that which rested upon it under the original appropriation, and while in the hands of the original appropriator, as he was entitled to and did use it. This principle is the necessary result of the fact that the only property in the water owned by the appropriator is a right to use it as measured by his appropriation.

In recognizing the validity of this sale, however, the court established a principle which makes the enlargement of rights not only possible but inevitable. In this particular transaction the seller retains his right to irrigate 700 acres of land, the buyer acquires a right to 10 cubic feet of water per second for half the time, with no restrictions as to where or how he is to use it.

SUMMARY.

This review has omitted many statements of specific facts because these are given in Mr. Teele's discussion. They seem to warrant the following conclusions:

(1) That the rights as established, if measured by the original use, are for excessive amounts of water.

(2) That this tends to augment the value of early rights to the injury of later ones.

(3) That the separation of rights from the place of original use renders it difficult to correct excess decrees.

(4) That the rights on some tributaries approach more nearly actual original uses than they do on others, hence a tabulation of the appropriations now vested in accordance with their priorities would not serve as an impartial standard for the division of water between States.

(5) That the limitations on property rights in the water of the river should be brought into an agreement, as a preliminary step to the division of water across State lines.

Leaving interstate questions out of account, what limitations should be imposed on appropriations? What is required to do justice to the appropriator and at the same time safeguard the rights of the public? In considering these questions we should remember that this water falls chiefly on public land: that by law it belongs to the public. In one of his messages to Congress President Roosevelt stated that the giving away in perpetuity of this property or of rights which control this property to other than actual users is open to all of the objections which apply to the granting of free and perpetual franchises to the public utilities of cities. There are objections to recognizing personal ownership in streams even if those rights are paid for, but under the liberal laws of Colorado and Wyoming not only is the appropriation secured without compensation, but the administration of the stream necessary to give these rights value is paid for by public taxation. In each of these States the rivers are gauged and the head gates regulated by public officers. The man whose interest in the stream has been given away pays for this service alike with the man who has been given that interest.

If the appropriation of water for a farm is attached to that farm and the right ceases with the cultivation of that farm, then the protection of that right by public officials is justified because men are thereby encouraged to settle on desert lands and make them productive. Furthermore, this right is not always perpetual. Whenever the cultivation of that land ceases the water reverts again to the public. But there will be no reversion, no abandonment of rights, if these rights can be rented or sold.

If the separate ownership of water and land is to be recognized, it would be better and safer to treat appropriations like franchises—instead of giving perpetual rights, give rights for a long period of time. There would be no objection to permitting canals to appropriate a certain number of cubic feet of water per second and permitting the owners of these canals to dispose of that water by rental or contract, if these appropriations were licenses and limited in time.

At the end of this time their inequalities with respect to each other and the evils which might have arisen in their management could be corrected. The possibility of such correction would be a potent hindrance to abuses. The experience of European countries shows that private capital is ready to undertake far costlier works than any built in this country for the diversion and storage of water under thirty-year licenses. Both canal companies and farmers realize that there is little danger of a just license not being renewed, and that there is great advantage to the people as a whole in having unjust ones corrected.

There are, however, circumstances under which rights to water should be separated from the place where acquired. As the country develops more water will be needed by cities and towns, by factories, and for household purposes. Where all the water is appropriated, as it is on many of the Platte's tributaries, these needs can only be supplied by extinguishing existing rights. But it is not necessary that water rights be made personal property in order to provide for this, nor is it necessary to sacrifice the doctrine of beneficial use as a standard for rights to provide for this. The State of Wyoming through its constitution has provided for the increasing needs of cities by authorizing them to take, through condemnation, any earlier right needed for this superior use. Here the doctrine of use is maintained by the transfer being effected through the supervision of the public authorities.

There are also cases where inferior lands have been irrigated or where lands have become unproductive by excess of water or alkali. If the right of this land to water can not be shifted the water will still be used there, while if it could be transferred to better land it would secure larger returns. Where these conditions exist the correction is not to be sought in making water rights personal property, or by giving a right to a certain number of cubic feet of water as an equivalent of the water used. The doctrine of use as a measure of the right can be maintained by simply shifting the right from the inferior land to an equal number of acres of better land. A preliminary requirement for all such shifts should be their approval and record by the State irrigation authorities. When such shift was made one acre would lose its right to water and another acre would succeed to it. Such transfers do not change the character of a right. They do not change the measure of a right. They do not surrender the principle of beneficial use, as the basis of a right.

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